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TRANSACTIONS

OF THE

AMERICAN

SURGICAL ASSOCIATION.

VOLUME THE FIFTEENTH.

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ELECTED MAY 6, 1897.

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THEODORE F. PREWITT, M.D.

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JAMES McFADDEN GASTON, A.B., M.D.
MAURICE HOWE RICHARDSON, A.B., M.D.

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PLACE OF NEXT MEETING.

NEW ORLEANS, APRIL, 1898.

COMMITTEE OF ARRANGEMENTS.

EDMOND SOUCHON, M.D.
CLAUDIUS H. MASTIN, M.D.
RUDOLPH MATAS, M.D.

LIST OF THE PRESIDENTS

OF THE

ASSOCIATION FROM THE TIME OF ITS INSTITUTION.

ELECTED

1880.† SAMUEL DAVID GROSS, M.D., LL.D., D.C.L. Oxon., LL.D. Cantab., LL.D. Edin.—Founder of the Association.

1883. EDWARD MOTT MOORE, M.D., LL.D.

1884.† WILLIAM THOMPSON BRIGGS, M.D.

1885.† MOSES GUNN, A.M., M.D., LL.D.

1886. HUNTER McGUIRE, M.D., LL.D.

1887.† D. HAYES AGNEW, M.D., LL.D.

1888. DAVID WILLIAMS CHEEVER, M.D., LL.D.

1889. DAVID W. YANDELL, M.D.

1890. CLAUDIUS HENRY MASTIN, M.D., LL.D.

1891. PHINEAS SANBORN CONNER, M.D., LL.D.

1892. NICHOLAS SENN, M.D., Ph.D., LL.D.

1893. J. EWING MEARS, A.M., M.D.

1894. FREDERIC SHEPARD DENNIS, M.D.

1895. LOUIS McLANE TIFFANY, A.M. Cantab., M.D.

1896. JOHN COLLINS WARREN, M.D.

1897. THEODORE F. PREWITT, M.D.

† Deceased.

NOTICE.

THIS volume of TRANSACTIONS contains the papers read before the Association at the Meeting held May 4, 5, and 6, 1897.

The Association assumes no responsibility for the statements and opinions published in this volume.

FELLOWS

OF THE

AMERICAN SURGICAL ASSOCIATION.

MAY, 1897.

* Denotes Original Fellows.

ELECTED

1890. ABBE, ROBERT, M.D., 13 West Fiftieth Street New York. Surgeon to St. Luke's Hospital.

1894. ALLEN, DUDLEY P., A.M., M.D., 278 Prospect Street, Cleveland, Ohio. Professor of Surgery, Medical Department, Western Reserve University; Visiting Surgeon, Lakeside and Charity Hospitals; Consulting Surgeon to the Cleveland City Hospital.

1890. ALLIS, OSCAR HUNTINGTON, A.M., M.D., 1604 Spruce Street, Philadelphia. Surgeon to the Presbyterian Hospital.

*1880. ASHHURST, JOHN, Jr., M.D., LL.D., 2000 West De Lancey Place, Philadelphia. Professor of Surgery and of Clinical Surgery in the University of Pennsylvania; Surgeon to the Pennsylvania Hospital; Senior Surgeon to the Children's Hospital. *Vice-President*, 1896.

1882. BARTON, JAMES M., A.M., M.D., 1337 Spruce Street, Philadelphia. Surgeon to the Jefferson Medical College Hospital and to the Philadelphia Hospital.

1896. BAXTER, GEORGE A., A.M., M.D., Chattanooga, Tennessee. Professor of Surgery, Chattanooga Medical College; Surgeon to Queen & Crescent and to Southern Systems; Surgeon to Nashville & Chattanooga, to Chattanooga Union, to Lookout Mountain, and to Electric System of Railways.

1882. BILLINGS, JOHN SHAW, M.D., LL.D., Edin. and Harv. Retired Deputy Surgeon-General U. S. A.; Astor-Tilden Library, New York. *Member of Council*, 1884–89.

ELECTED

1882. Bontecou, Reed Brockway, M.D., 82 Fourth Street, Troy, N. Y. Surgeon to the Marshall Infirmary.

1890. Bradford, Edward Hickling, A.B., M.D., 133 Newbury Street, Boston. Surgeon to the Children's and the Samaritan Hospitals; Assistant Professor of Orthopædic Surgery in Harvard University.

*1880. Brinton, John H., M.D., 1423 Spruce Street, Philadelphia. Professor of the Practice of Surgery and of Clinical Surgery in the Jefferson Medical College; Surgeon to St. Joseph's Hospital. *Treasurer*, 1884–85.

1895. Bryant, Joseph D., M.D., 54 West Thirty-sixth Street, New York. Professor of Anatomy and of Operative and Clinical Surgery, Bellevue Hospital Medical College; Surgeon to Bellevue and St. Vincent's Hospitals; Consulting Surgeon to Gouveneur Hospital, Hospital for Ruptured and Crippled, St. Joseph's, and Hackensack Hospitals, Asylum for Insane, New York, etc.

1882. Bull, William Tillinghast, A.B., M.D., 35 West Thirty-fifth Street, New York. Adjunct Professor of the Practice of Surgery and of Clinical Surgery in the College of Physicians and Surgeons, New York; Surgeon to the New York and St. Luke's Hospitals; Consulting Surgeon to the Hospital for Ruptured and Crippled, and to the New York Cancer Hospital.

1893. Burrell, Herbert Leslie, M.D. (Harvard), *Secretary*, 22 Newbury Street, Boston, Mass. Assistant Professor of Clinical Surgery in Harvard University; Visiting Surgeon, Boston City Hospital; Visiting Surgeon, The Children's Hospital; Consulting Surgeon, Carney Hospital and the Quincy Hospital.

1889. Cabot, Arthur Tracy, A.M., M.D., 3 Marlborough Street, Boston, Mass. Surgeon to the Massachusetts General Hospital.

1885. Carmalt, William H., A.M., M.D., 87 Elm Street, New Haven, Conn. Professor of Surgery in Yale University; Surgeon to the New Haven Hospital *Vice-President*, 1895.

1896. Carson, Norman Bruce, M.D., 209 North Jefferson Avenue, St. Louis, Mo. Professor of Clinical Surgery in St. Louis Medical College; Surgeon to the St. Louis, Mullanphy, and Martha Parsons' Hospitals, St. Vincent Insane Asylum, etc.

1882. Cheever, David Williams, M.D., LL.D., 557 Boylston Street,

ELECTED

Boston, Mass. Professor of Surgery (Emeritus) in Harvard University; Surgeon to the Boston City Hospital. *President*, 1888.

1896. Cole, Charles Knox, A.M., M.D., Helena, Montana. Surgeon to St. John's, St. Peter's, and County Hospitals.

*1880. Conner, Phineas Sanborn, M.D., LL.D., 159 West Ninth Street, Cincinnati, Ohio. Professor of Surgery in the Medical College of Ohio; Professor of Surgery, Dartmouth Medical College; Surgeon to the Cincinnati and the Good Samaritan Hospitals. *President*, 1891; *Member of Council*, 1883 and 1895–97; *Treasurer*, 1885–91.

1896. Curtis, Benjamin Farquhar, A.B., M.D., 7 East Forty-first Street, New York. Professor of Clinical Surgery in the New York Post-Graduate Medical School, and Women's Medical College of the New York Infirmary; Surgeon to St. Luke's and New York Cancer Hospitals; Consulting Surgeon to New York Orthopædic Hospital and Dispensary and the New York Infirmary for Women and Children.

1896. Cushing, Hayward Warren, A.B., M.D., 70 Commonwealth Avenue, Boston, Mass. Assistant Visiting Surgeon, Boston City Hospital; Assistant Surgeon, Children's Hospital, Boston.

1897. Da Costa, John Chalmers, M.D., 1629 Locust Street, Philadelphia, Pa. Clinical Professor of Surgery, Jefferson Medical College; Surgeon to the Philadelphia and the Phœnixville Hospitals, and to the Pennsylvania Training School for Feeble Minded, Elwyn, Pa.

1883. Dandridge, Nathaniel Pendleton, M.D. 422 Broadway, Cincinnati, Ohio. Professor of Practice of Surgery and of Clinical Surgery in the Miami Medical College, Cincinnati. *Treasurer*, 1894–96.

1892. Deaver, John B., M.D., 1634 Walnut Street, Philadelphia. Professor of Applied Anatomy, University of Pennsylvania; Surgeon to the Philadelphia and German Hospitals, Philadelphia.

1882. Dennis, Frederic Shepard, M.D., 542 Madison Avenue, New York. Professor of the Principles and Practice of Surgery in the Bellevue Hospital Medical College; Surgeon to the Bellevue and St. Vincent's Hospitals; Consulting Surgeon to the Hospital for Ruptured and Crippled. *President*, 1894; *Vice-President*, 1887; *Member of Council*, 1889.

ELECTED

1893. Elliot, John Wheelock, A.M., M.D. (Harvard), 124 Beacon Street, Boston. Surgeon to Massachusetts General Hospital.

1896. Estes, William Lawrence, A.M., M.D., South Bethlehem, Penna. Director and Surgeon-in-Chief of St. Luke's Hospital; Lecturer on Hygiene at Lehigh University.

1883. Fenger, Christian, M.D., 269 La Salle Avenue, Chicago. Professor of Clinical Surgery in the Northwestern University Medical School and the Chicago Polyclinic; Surgeon to Emergency, German, Mercy, and Norwegian Hospitals. *Vice-President*, 1895.

1882. Forbes, William Smith, M.D., 901 Pine Street, Philadelphia. Professor of Anatomy in the Jefferson Medical College of Philadelphia; Surgeon to the Protestant Episcopal Hospital.

1891. Fowler, George Ryerson, M.D., *Treasurer*, 302 Washington Avenue, Brooklyn, New York. Professor of Surgery, New York Polyclinic; Examiner in Surgery, Medical Examining Board of Regents, University State of New York; Surgeon to the Methodist Episcopal Hospital and the Brooklyn Hospital; Consulting Surgeon to the Norwegian, the Relief (E. D.), and the Bushwick Hospitals.

1891. Gaston, James McFadden, A.B., M.D., *Vice-President*. 421 Capitol Avenue, Atlanta, Georgia. Professor of Surgery in Southern Medical College.

1882. Gay, George Washington, M.D., 665 Boylston Street, Boston, Mass. Surgeon to the Boston City Hospital; Clinical Instructor in Surgery in Harvard University. *Member of Council*, 1882.

1892. Gerrish, Frederic Henry, A.M., M.D., 675 Congress Street, Portland, Maine. Consulting Surgeon, Maine General Hospital; Professor of Anatomy in Medical Department of Bowdoin College.

1890. Gerster, Arpad G., M.D., Chir.D., 34 East Seventy-fifth Street, New York. Professor of Surgery in the New York Polyclinic; Surgeon to the German and Mount Sinai Hospitals.

1892. Halsted, William Stewart, B.A., M.D., 1201 Eutaw Place, Baltimore, Md. Surgeon to Johns Hopkins Hospital.

ELECTED

1895. HARTE, RICHARD H., M.D., 1503 Spruce Street, Philadelphia. Demonstrator of Osteology in the University of Pennsylvania; Surgeon to the Pennsylvania and Episcopal Hospitals; Assistant Surgeon to the University Hospital; Consulting Surgeon, St. Mary's and St. Timothy's Hospitals.

1889. HOMANS, JOHN, A.B., M.D., 164 Beacon Street, Boston. Surgeon to the Massachusetts General Hospital.

1882. ISHAM, RALPH N., A.M., M.D., 321 Dearborn Avenue, Chicago. Professor of the Principles and Practice of Surgery in the Chicago Medical College (Medical Department of the Northwestern University).

1896. JOHNSTON, GEORGE BEN, M.D., 207 East Grace Street, Richmond, Va. Professor of the Practice of Surgery and of Clinical Surgery in the Medical College of Virginia; Surgeon to the Old Dominion Hospital, and Consulting Surgeon to the Richmond City Free Dispensary.

*1880. KEEN, WILLIAM WILLIAMS, A.M., M.D., LL.D., 1729 Chestnut Street, Philadelphia. Professor of the Principles of Surgery and of Clinical Surgery in the Jefferson Medical College; Surgeon to the Jefferson Medical College Hospital and to the Orthopædic Hospital and Infirmary for Nervous Diseases; Consulting Surgeon to the Woman's and St. Agnes's Hospitals; Membre Correspondant Etrangé de la Société de Chirurgie de Paris; Membre Honoraire de la Société Belge de Chirurgie. *Vice-President*, 1892.

1890. LANE, LEVI COOPER, A.M., M.D., M.R.C.S. Eng., LL.D., San Francisco, Cal. Professor of Surgery in the Cooper Medical College, San Francisco. *Vice-President*, 1891.

1889. LANGE, FREDERICK E., M.D., 691 Lexington Avenue, New York.

*1880. MARKS, SOLON, M.D., 136 Wisconsin Street, Milwaukee, Wis. Surgeon to St. Mary's Hospital.

*1880. MASTIN, CLAUDIUS HENRY, M.D., LL.D. (Univ. of Penna.), Northwest corner Joachim and Conti Streets, Mobile, Ala. *President*, 1890; *Vice-President*, 1889; *Member of Council*, 1891, '94, '95.

ELECTED

1887. MASTIN, WILLIAM MCDOWELL, M.D., Northwest corner of Joachim and Conti Streets, Mobile, Ala.

1895. MATAS, RUDOLPH, M.D., 2255 St. Charles Street, New Orleans, La. Professor of Surgery, Medical Department, Tulane University; Professor of Clinical Surgery, New Orleans Polyclinic; Surgeon to Charity Hospital; Consulting Surgeon to the Eye, Ear, Nose, and Throat Hospital.

1896. MCCOSH, ANDREW J., B.A., M.D., 22 East Fifty-Sixth Street, New York. Surgeon to the Presbyterian Hospital; Clinical Lecturer on Surgery, College of Physicians and Surgeons.

1882. MCGRAW, THEODORE A., M.D., 107 West Fort Street, Detroit, Michigan. Professor of Surgery in the Detroit Medical College; Surgeon to St. Mary's and the Harper Hospitals. *Vice-President*, 1896.

*1880. MCGUIRE, HUNTER, M.D., LL.D., 513 East Grace Street, Richmond, Va. President of the College of Physicians and Surgeons and Professor of Clinical Surgery. *President*, 1886; *Member of Council*, 1880–85.

*1880. MEARS, J. EWING, A.M., M.D., 1429 Walnut Street, Philadelphia. Professor of Anatomy and of Clinical Surgery in the Pennsylvania College of Dental Surgery. *President*, 1893; *Recorder*, 1881–93.

1893. MIXTER, SAMUEL JASON, S.B. (Massachusetts Institute of Technology), M.D. (Harvard), 180 Marlborough Street, Boston. Surgeon to Massachusetts General Hospital and to Carney Hospital; Consulting Surgeon to the Massachusetts Charity Eye and Ear Infirmary; Instructor in Surgery in the Harvard University.

1896. MONKS, GEORGE HOWARD, A.B. (Harvard), M.D. (Harvard), M.R.C.S. (Eng.), 405 Boylston Street, Boston. Surgeon to Carney Hospital; Assistant Visiting Surgeon, Boston City Hospital; Instructor in Clinical and Assistant in Operative Surgery, Harvard Medical School; Instructor in Surgical Pathology, Harvard Dental School.

1895. MOORE, JAMES E., M.D., 802 Dayton Building, Minneapolis, Minn. Professor of Orthopædic and Clinical Surgery, University of Minnesota; Surgeon to St. Barnabas and Northwestern Hospitals; Consulting Surgeon to St. Mary's and City Hospitals.

*1880. MORTON, THOMAS GEORGE, M.D., 1421 Chestnut Street, Philadelphia. Surgeon to the Pennsylvania, the Orthopædic, and the Jewish Hospitals.

ELECTED.

1886. MUDD, HENRY H., M.D , 2604 Locust Street, St. Louis, Mo. Professor of Surgical Anatomy and Clinical Surgery in St. Louis Medical College; Surgeon to St. Luke's Hospital.

1882. NANCREDE, CHARLES BEYLARD, A.M., M.D., Ann Arbor, Mich. Professor of Surgery in the University of Michigan. *Vice-President*, 1889.

1882. OWENS, JOHN E., M.D., 1806 Michigan Avenue, Chicago. Professor of Principles and Practice of Surgery and Clinical Surgery in the Chicago Medical College; Surgeon to St. Luke's Hospital.

*1880. PACKARD, JOHN H., M.D., 225 South Sixteenth Street, Philadelphia. Surgeon to St. Joseph's Hospital. *Treasurer*, 1880–83.

1885. PARK, ROSWELL, A.M., M.D., 510 Delaware Avenue, Buffalo, N. Y. Professor of Surgery in the Medical Department of the University of Buffalo; Surgeon to the Buffalo General Hospital; Consulting Surgeon to the Fitch Accident Hospital. *Vice-President*, 1893; *Member of Council*, 1893–94.

1896. PARKHILL, CLAYTON, M.D., 205–6 McPhee Building, Denver, Col. Dean of the Colorado School of Medicine, Medical Department of the University of Colorado, and Professor of the Principles and Practice of Surgery and Clinical Surgery in the same; Surgeon to St. Luke's and the Arapahoe County Hospitals, Denver; Surgeon-in-Chief to the Citizens' Hospital, Aspen, Col.; Consulting Surgeon to the State Hospital for the Insane, Pueblo, Col.; Surgeon-General of the National Guard of Colorado.

1893. PARMENTER, JOHN, M.D., 519 Franklin Street, Buffalo, N. Y. Professor of Anatomy and Clinical Surgery in the Medical Department of the University of Buffalo; Surgeon to the Erie County, Fitch, and Children's Hospitals; Assistant Surgeon to the Buffalo General Hospital.

1889. PILCHER, LEWIS S., A.B., M.D., 145 Gates Avenue, Brooklyn, N. Y. Professor of Clinical Surgery in the Post-Graduate Medical School, New York; Surgeon to the Methodist Episcopal Hospital. *Vice-President*, 1893.

1887. PORTER, CHARLES BURNHAM, A.M., M.D. (Harv.), 5 Arlington Street, Boston, Mass. Professor of Clinical Surgery in Harvard University; Surgeon to the Massachusetts General Hospital. *Vice-President*, 1892.

ELECTED.

1882. PORTER, WILLIAM GIBBS, M.D., 1118 Spruce Street, Philadelphia. Surgeon to the Presbyterian and Philadelphia Hospitals.

1896. POWERS, CHARLES A., M.D., Fourteenth and Stout Streets, Denver, Col. Professor of Surgery in the University of Colorado, and Surgeon to the Arapahoe County Hospital.

1882. PREWITT, THEODORE F., M.D., *President*, 3101 Pine Street, St. Louis, Mo. Professor of the Principles and Practice of Surgery and Clinical Surgery in the Missouri Medical College; Surgeon to St. John's Hospital. *Vice-President*, 1886; *Member of Council*, 1894–96.

1886. RANSOHOFF, JOSEPH, M.D., F.R.C.S. (Eng.), 706 Walnut Street, Cincinnati, Ohio. Professor of Anatomy in the Medical College of Ohio; Surgeon to the Cincinnati and the Good Samaritan Hospitals.

1887. RICHARDSON, MAURICE HOWE, A.B., M.D., *Vice-President*, 224 Beacon Street, Boston, Mass. Surgeon to the Massachusetts General Hospital; Assistant Professor of Clinical Surgery in Harvard University. *Secretary*, 1894–96.

1882. ROBERTS, JOHN B., A.M., M.D., 1627 Walnut Street, Philadelphia. Professor of Anatomy and Surgery in the Philadelphia Polyclinic; Professor of Surgery in the Woman's Medical College of Pennsylvania; Surgeon to the Methodist and the Jewish Hospitals. *Vice-President*, 1888 and 1894; *Treasurer*, 1892–93.

1882. RUSHMORE, JOHN DIKEMAN, M.D., 129 Montague Street, Brooklyn, N. Y. Professor of Surgery in the Long Island College Hospital; Surgeon to the Brooklyn, the St. Peter's, and the Eye and Ear Hospitals.

*1880. SAYRE, LEWIS ALBERT, M.D., 285 Fifth Avenue, New York. Professor of Orthopædic Surgery in the Bellevue Hospital Medical College; Consulting Surgeon to the Bellevue, the Charity, and the St. Elizabeth's Hospitals, and to the Home for Incurables.

1882. SENN, NICHOLAS, M.D., Ph.D., LL.D., 532 Dearborn Avenue, Chicago, Ill. Professor of the Principles of Surgery and Clinical Surgery in Rush Medical College; Surgeon to the Presbyterian Hospital; Surgeon-in-Chief to St. Joseph's Hospital. *President*, 1892; *Member of Council*, 1897.

ELECTED.

1895. SOUCHON, EDMOND, M.D., 135 Baronne Street, New Orleans, La. Professor of Anatomy and of Clinical Surgery, Tulane University; Surgeon to Charity Hospital; Consulting Surgeon to the Eye, Ear, Nose, and Throat Hospital.

1889. STIMSON, LEWIS A., M.D., 34 East Thirty-third Street, New York. Professor of Surgery in the University of New York.

1885. THOMPSON, J. FORD, M.D., 1401 H Street, N. W., Washington, D. C. Professor of Surgery in the National Medical College; Surgeon to the Garfield Memorial and the Children's Hospitals.

1882. THOMSON, WILLIAM, M.D., 1426 Walnut Street, Philadelphia. Honorary Professor of Ophthalmology in the Jefferson Medical College Hospital.

1882. TIFFANY, LOUIS MCLANE, A.M. (Cantab.), M.D., 831 Park Avenue, Baltimore, Md. Professor of Surgery in the University of Maryland; Surgeon to the University Hospital. *President*, 1895; *Member of Council*, 1885–89, and 1896–97.

1882. VANDER VEER, ALBERT, A.M., M.D., Ph.D., 28 Eagle Street, Albany, N. Y. Professor of Abdominal Surgery and of Clinical Surgery in the Albany Medical College; Consulting Surgeon to St. Peter's Hospital; Attending Surgeon to the Albany Hospital.

1891. WALKER, EDWARD W., M.D., 96 West Eighth Street, Cincinnati, Ohio. Professor of Surgery, Miami Medical College.

1882. WARREN, JOHN COLLINS, M.D., 58 Beacon Street, Boston, Mass. Professor of Surgery in Harvard University; Surgeon to the Massachusetts General Hospital. *President*, 1896; *Vice-President*, 1890; *Member of Council*, 1897.

1896. WATSON, FRANCIS SEDGWICK, A.B., M.D., 92 Marlborough Street, Boston. Surgeon to the Boston City Hospital; Instructor in Genito-Urinary Surgery, Harvard Medical School.

1889. WEEKS, STEPHEN H., M.D., 662 Congress Street, Portland, Maine. Professor of Surgery in the Medical School of Maine; Surgeon to Maine General Hospital. *Member of Council*, 1893.

1889. WEIR, ROBERT F., M.D., 37 West Thirty-third Street, New York. Professor of Clinical Surgery in the College of Physicians and Surgeons; Surgeon to the New York Hospital; Consulting Surgeon to the Roosevelt and St. Luke's Hospitals. *Member of Council*, 1893–1896.

ELECTED.

*1880. WEIST, JACOB ROWLAND, A.M., M.D., 118 North Eighth Street, Richmond, Ind. Surgeon to St. Stephen's Hospital. *Vice-President*, 1894; *Secretary*, 1880–94.

1892. WHARTON, HENRY R., A.M., M.D., 1725 Spruce Street, Philadelphia. Demonstrator of Surgery, University of Pennsylvania; Surgeon to the Presbyterian, the Children's, and the Methodist Hospitals; Assistant Surgeon to the University Hospital.

1882. WHITE, J. WILLIAM, M.D., Ph.D., 1810 South Rittenhouse Square, Philadelphia. Professor of Clinical Surgery in the University of Pennsylvania.

1891. WIGHT, JARVIS SHERMAN, A.M., M.D., LL.D., 30 Schermerhorn Street, Brooklyn, N. Y. Professor of Operative and Clinical Surgery, Long Island College Hospital; Surgeon to Long Island College Hospital; Consulting Surgeon to St. Mary's Hospital.

1882. WILLARD, DE FOREST, A.M , M.D., (Univ. of Pa.), Ph.D., *Recorder*, 1601 Walnut Street, Philadelphia. Surgeon to the Presbyterian Hospital; Clinical Professor of Orthopædic Surgery in the University of Pennsylvania; Consulting Surgeon to the Hospital for the Chronic Insane of Pennsylvania, and to the New Jersey Training School for Feeble-minded.

HONORARY FELLOWS.

ELECTED

1885. ANNANDALE, THOMAS, M.D., 34 Charlotte Square, Edinburgh, Scotland. Regius Professor of Clinical Surgery in the University of Edinburgh.

1894. VON BERGMANN, PROF. DR. ERNST, Geh. Med. Rath., Klin. Institut für Chirurgie, Berlin, Germany.

1891. BRYANT, THOMAS, ESQ., F R.C.S., Eng., 65 Grosvenor Street, Grosvenor Square, London, W., England.

1891. CHIENE, JOHN, M.D., F.R.C.S., Edin., 26 Charlotte Square, Edinburgh, Scotland. Professor of Surgery in the University of Edinburgh.

1885. CZERNY, PROF. DR. VINCENT, 25 Sophien Strasse, Heidelberg, Germany. Professor of Surgery in the University of Heidelberg.

1885. VON ESMARCH, PROF. DR. FRIEDRICH, 2 Hospitalberg, Kiel, Schleswig-Holstein, Germany. Professor of Surgery in the University of Kiel.

1893. GUSSENBAUER, PROF. DR. CARL, ix. Ferstelgasse 5, Vienna. Imperial and Royal Professor of Surgery and Chief of the Second Surgical Clinic and of the Surgical Institute.

1891. HARRISON, REGINALD, ESQ., F.R.C.S., Eng., 6 Lower Berkeley Street, Portman Square, W., London, England.

1890. HORSLEY, VICTOR, F.R.C.S., Eng., 25 Cavendish Square, London, W., England.

1883. HORWITZ, P. J., M.D., 1919 Walnut Street, Philadelphia. Medical Director U. S. Navy (Retired), Philadelphia.

1894. KOCHER, PROF. DR. THEODOR, Professor of Surgery, University of Berne, Villette 25, Berne, Switzerland.

1885. LISTER, LORD, D.C.L., LL.D., F.R.C.S., Eng., 12 Park Crescent, London, W., England. Professor of Clinical Surgery in King's College, London.

ELECTED

1886. MacCormac, Sir William, Bart., F.R.C.S., England and Ireland, 13 Harley Street, London, W., England. Surgeon to St. Thomas's Hospital.

1894. Macewen, William, M.D., 3 Woodside Crescent, Glasgow, Scotland.

*1880. Moore, Edward Mott, M.D., LL.D., 74 South Fitzhugh Street, Rochester, N. Y. Surgeon to St. Mary's Hospital. *President*, 1884.

1887. Ollier, Prof. Dr. Leopold, 3 Quai de la Charité, Lyons, France.

1885. Paget, Sir James, Bart., D.C.L., LL.D., F.R.C.S., Eng., 5 Park Square, W., Regent's Park, London, England.

1894. Péan, Dr. Jules E., 24 Boulevard Malesherbes, Paris. Member Academy of Medicine; Surgeon to International Hospital; Commandant Legion of Honor.

1894. Schede, Prof. Dr., Geh. Med. Rath., Director of Surgery, University Clinic, Bonn, Germany.

1882. Smith, Stephen, A.M., M.D., LL.D., 574 Madison Avenue, New York. Professor of Clinical Surgery in the University Medical College of New York; Surgeon to the Bellevue and the St. Vincent's Hospitals. *Vice-President*, 1890.

1896. Terrier, Dr. Felix, 3 Rue de Copenhague, Paris. Professor of Operative Surgery in the Faculty of Medicine of Paris; Surgeon to the Hôpital Bichat.

*1880. Yandell, David W., M.D., 706 West Chestnut Street, Louisville, Ky. Professor of the Principles of Surgery and of Clinical Surgery in the Medical Department of the University of Louisville. *President*, 1889.

* Original Fellows.

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REPORT OF THE COMMITTEE ON NECROLOGY.

SIR THOMAS SPENCER WELLS, F.R.C.S.

Born February 3, 1818. Died January 31, 1897.

Sir Thomas Spencer Wells, F.R.C.S., who established ovariotomy on a firm basis and proved that it was a reasonable and imperative operation, died suddenly of apoplexy on January 31st of this year at Cap d'Antibes, near Cannes. Sir Spencer was born at St. Albans on February 3, 1818. As a boy he was interested in the habits of animals, and when still quite a lad worked for one of the surgeons of Leeds and attended the lectures of Hey and Teale. When nineteen years old he went to Trinity College, Dublin, and attended the lectures of Sir Philip Crampton on surgery, and particularly those of Arthur Jacob on diseases of the eye.

In 1841 he became a member of the College of Surgeons, and entered the Royal Navy. For six years he served in the Naval Hospital at Malta, and also practised among the civilians at that post. In 1848 he resigned from the navy and went to Paris, where he remained two years and listened to the lectures and witnessed the experiments of Magendie and Claude Bernard. In 1854 he was chosen surgeon to the Samaritan Hospital for Women, but the outbreak of the Crimean War took him to the front, and he went to the Crimea.

In 1856 he returned to London from the war in the Crimea and began his service at the Samaritan Hospital. During his service at the seat of war he had an opportunity to study many wounds of the abdomen, and he noticed that the peritoneum was very tolerant to handling, if it was kept clean, and carefully and tenderly treated; he was the first to notice the importance of this remarkable tolerance of the peritoneum. He was an observer; the wonderful recoveries after abdominal injuries from shell-wounds were not exhibited to blind eyes.

In December, 1857 his first attempt at ovariotomy was done in

London, but he could not complete the operation and remove the tumor, and the case was fatal. It was not till February, 1858, that he completed his first ovariotomy.

Even then it required great boldness to open the abdomen for any purpose, and especially to do an ovariotomy. Wells was a deliberate, painstaking operator. He prepared himself and his materials carefully, and was especially quiet while operating.

His mechanical ingenuity and the manual dexterity which he had acquired as an ophthalmic surgeon stood him good stead. He pledged himself to make known all his cases with their results. This he did, and thus established his favorite operation on a sure footing.

Although his percentage of success in his first hundred cases, done between 1858 and 1864, was low, yet he honestly published them all, and gradually his success became better.

In June, 1880, Spencer Wells did his thousandth ovariotomy, and before he died did several hundred more. To him it was given to see the wonderful rise and progress of abdominal surgery, born of ovariotomy and made successful by Listerism. For twenty years he operated at the Samaritan Hospital, resigning in 1878.

When Sir Spencer Wells *began* to do ovariotomy there was no literature on abdominal surgery; the operation of ovariotomy was not mentioned in the medical text-books, nor referred to in lectures; when he *died* it was impossible for one man to read in twenty-four hours all the articles published on abdominal surgery during the same space of time. He could not but have thrilled at the glorious thought that the operation which he had established was the basis from which had sprung all this surgery of the peritoneal organs.

Sir Spencer published four books and many practical and interesting articles in the medical journals. The first volume of *Diseases of the Ovaries, their Diagnosis and Treatment*, published in 1865, gives a detailed account of one hundred and fourteen cases of completed ovariotomy and also cases of exploratory incisions and partially completed cases. It is an octavo volume of some four hundred pages, giving every case at great length; some of them cover four pages. It is by far the best of all his books, and an ovariotomist can learn more from it than from any other work. No second volume was ever issued. His other works were published later; one in 1872, under the title mentioned above; another in 1882 entitled, *Ovarian and Uterine Tumors*, and one in 1885 on *The Diagnosis and Treatment of Abdominal Tumors*. His works were translated into foreign languages.

As was fitting, he was highly honored in England and on the continent. The Universities of Leyden and Bologna conferred on him honorary degrees; he was likewise honored by the University of Charkof, and was a Knight-Commander of the Norwegian Order of St. Olaf. He was a fellow of almost all the medical societies of the great cities of Europe, and on May 11, 1883, Her Majesty conferred on him the honor of a Baronetcy in recognition of his services to medical science and humanity. He was elected Honorary Fellow of the American Surgical Association in 1894. If we should credit him with one thousand recoveries after operations, and allow only twelve years of life to the recovered patients, we shall see that Sir Spencer, by performing the operation which he established, has, with the blessing of God, added at least twelve thousand years to human life. To no one surgeon will it ever be given to do so much for humanity.

SIR JOHN ERIC ERICHSEN, BART., F.R.S., LL.D.

Born July 19, 1818. Died September 23, 1896.

JOHN ERIC ERICHSEN was born at Copenhagen, Denmark, on July 19, 1818, being the eldest son of Eric Erichsen a banker of that city. His mother was a Somersetshire lady of an ancient family in that county. John Erichsen was brought up in England, his early education having been received at the Mansion House, Hamersmith, a large private school, from which he entered University College. During his student days Liston was the Professor of Surgery in University College, and Erichsen being "a man born with surgical instinct, by nature and by taste a surgeon," devoted himself heart and soul to the art to which he was destined to become so distinguished an exponent. In 1839 he became a member of the Royal College of Surgeons of England, and six years later became a Fellow by examination. In 1880 he was elected President of the College. He lectured on physiology at Westminister Hospital for a short time after the completion of his professional studies at University College, after which he was chosen assistant surgeon to University College. On the death of Professor Liston, in 1847, he was appointed Professor of Surgery and full surgeon to the hospital, being at that time twenty-nine years of age. Defective vision presented an almost insuperable obstacle to his ever becoming a brilliant operator; he was, however, a careful one, very

skilful in the after-treatment of his cases. He was a skilful diagnostician, a sound reasoner, with plenty of logical good sense. He was a general surgeon in the completest sense, a sound anatomist, an excellent pathologist and well equipped with practical knowledge. To the study of the remote injuries to the nervous system caused by shock, more especially such as are met with as a result of railway collisions and similar accidents, he devoted much time and attention. Concussion of the spine was a subject which he made peculiarly his own, and he issued in 1866 six lectures on this subject which attracted wide and general attention. The issue of these lectures brought to him a very large accession of practice of a special nature.

In 1853 his great work, *The Science and Art of Surgery*, appeared and met at once with approval. In all the treatise has run through ten large editions in England, as well as having been translated into nearly every European language. In the United States, during the Civil War, the government had a special edition published, and distributed a copy to every surgeon in the service. As the author of this monumental work his name will live.

Sir John Erichsen was the recipient of many honors, among them the Doctorate of Laws of Edinburgh University, the Fellowship of the Royal Society, and the Honorary Mastership of Surgery of the Royal University of Ireland. He was also an Honorary Fellow of numerous learned societies throughout Europe and America. He was elected an Honorary Fellow of the American Surgical Association in 1885. He was Senior Surgeon-Extraordinary to the Queen, and in January, 1895, Her Majesty conferred on him the honor of a Baronetcy. Sir John Erichsen's popularity with his colleagues and with his pupils was unbroken, and his genial hospitality and unvarying kindness earned for him the love and respect of all who had the privilege of his society. He possessed great charm of manner and amiability of disposition.

The name of Sir John Erichsen will take rank among those of the great surgeons of modern times. His contributions to surgical literature made their impress upon the practice of surgery throughout the entire world.

SIR GEORGE MURRAY HUMPHRY, M.D. CANTAB., LL D. EDIN., SC.D., F.R.C.S. ENG., F.R.S.

Born July 18, 1820. Died September 24, 1896.

SIR GEORGE MURRAY HUMPHRY was born on July 18, 1820, at Sudbury in Suffolk, England. He received his early education at Sudbury and Dedham Grammar School, and in the year 1836 was apprenticed to Mr. Crosse, of Norwich, then in the height of his fame as a surgeon. After leaving Norwich he entered St. Bartholomew's Hospital, and at the end of a year he passed the first examination for the Degree of Bachelor of Medicine at London University. In this examination he won the gold medal in anatomy. In 1842 he was elected surgeon to Addenbrooke's Hospital at Cambridge, a position of honor and responsibility. In 1844, although he had not reached the statutory age of five and twenty, the Royal College of Surgeons of England conferred on him the honorary title of Fellow. In 1849–50 he entered on his university course at Downing College, at the same time engaged in general practice both in Cambridge and its immediate neighborhood. In 1852 he graduated M.B. of the University of Cambridge, and in 1856 as M.D. On the resignation of the Professor of Anatomy he was elected to the vacant post, and on the establishment of a professorship of surgery he resigned the chair of anatomy and was elected Professor of Surgery. He was very much devoted to the University School of Medicine, the interest of which ever occupied his most earnest thought. He occupied positions of honor in the Royal College of England, the General Medical Council and the British Medical Association. He was a member of many learned societies in Great Britain and on the continent. In 1896 he was elected an Honorary Fellow of the American Surgical Association. In 1891 he received the honor of Knighthood. His contributions to medical and surgical literature, though not voluminous, embrace a wide list of subjects. The work on *The Human Skeleton* gave him a world-wide reputation as an anatomist of great learning and of great originality, and his paper on "Observations on the Limbs of Vertebrate Animals" proved that he was a great comparative anatomist as well as a great human anatomist. The contribution which earned for him the most popular attention, not only among the members of the profession but also among lay-readers, was that on *The Human Foot and Human Hand.* It contained much valuable matter and was full of interest.

His ability as a teacher was well known and recognized in the University. He delighted in teaching for the sake of instruction, and to him the imparting of knowledge to others was always a pleasant and grateful task. With the stupid or careless he was severe, toward the earnest worker he was full of helpfulness and kindly feeling. Strict accuracy of observation and expression were the leading features of his teaching. As a surgeon he possessed, in an eminent degree, the clinical instinct, the result of years of laborious observation. His popularity and fame as a teacher induced numbers of young men to enter the profession who possessed the internal qualities as well as the external manners of gentlemen, and he did more than any one man to improve the position of medicine in the social scale. As a lecturer he was original and most impressive and instructive. On the subject of osteology he was peculiarly instructive, and he was perhaps one of the few teachers of whom it may be said "He made the dry bones to live." He was an intrepid surgeon, perfectly firm and self-reliant, with an absolute contempt for sudden and severe hemorrhage. Under increasing difficulties or unexpected emergencies in an operation he became the more cool and collected.

His home life, brightened by a most excellent and devoted wife, was bright and happy, and the true liberality of his character was shown in his unbounded hospitality. His pleasures were both social and intellectual, and his delight was in the duties of his life, and as such he was a truly happy man. To his more intimate friends his kindness and hospitality were almost lavish, and he never forgot young men he thought to be hardworking and deserving. His death removes one of the great medical men of our time.

WILLIAM HUNT, M.D.

Born September 26, 1825. Died April 17, 1896.

Dr. William Hunt, an Honorary Fellow of the American Surgical Association, was born September 26, 1825, in Philadelphia. His family, who were Friends, came to America in 1680 from Scotland, and settled in New Jersey and Pennsylvania. Dr. Hunt received his early education at the Friends Select School, and on its completion entered into mercantile life. Finding this life not in accordance with his tastes he entered the Medical Department of the University of Penn-

sylvania, and received his degree of medicine in 1849. After his graduation he entered the Pennsylvania Hospital as a substitute, and shortly afterward was elected as a regular member of the resident staff. In 1854 he became Demonstrator of Anatomy in the University of Pennsylvania, Dr. Leidy, the eminent scientist, being at that time Professor of Anatomy. In 1853 he was elected Surgeon to the Episcopal Hospital, and in 1857 Surgeon to Wills Eye Hospital. In 1863 he was chosen Surgeon to the Pennsylvania Hospital, which position he held for a period of thirty years. He was also Attending Surgeon to the Orthopedic Hospital, as well as Consulting Surgeon to the Pennsylvania Institution for the Deaf and Dumb.

He was a member of the American Medical Association, the Academy of Natural Sciences, Fellow of the College of Physicians, Philadelphia, Fellow and for two terms President of the Philadelphia Academy of Surgery.

During the Civil War he was acting Assistant Surgeon in the United States Army, and, under the direction of the Government, for a time performed the duties of Inspector of Hospitals under the charge of the Sanitary Commission.

He contributed a number of articles to the medical journals, and edited, in 1858, Wilson's *Dissector Manual.*

In the hospital clinics held by him he was an attractive and instructive lecturer. As a surgeon he was a judicious and safe operator, and as a consultant he possessed excellent judgment. Of a modest an unselfish character, he was esteemed and loved by all who knew him.

WILLIAM H. PANCOAST, M.D.

Born 1835. Died January 5, 1897.

Dr. William H. Pancoast, the son of Dr. Joseph Pancoast, the eminent surgeon, was born in Philadelphia in 1835. He received his early education in the schools of Philadelphia, and afterward entered Haverford College, from which he graduated. Entering Jefferson Medical College, in which his father occupied the Chair of Anatomy, he graduated in 1856, and in 1862 he was appointed Demonstrator of Anatomy. In 1874, on the retirement of his father, he was elected to the Chair of Anatomy, which he occupied for several years. On his resignation from Jefferson Medical College he became Professor of

Anatomy in the Medico-Chirurgical College, and took an active part in its development.

His contributions to surgical literature were made to medical journals, and some appeared in the volumes of *Transactions* of the societies of which he was a member. He took a great interest and an active part in bringing the bodies of the Siamese Twins to Philadelphia for dissection at the College of Physicians. As a member of the Committee on the part of the College of Physicians he made a report on the dissection of the bodies. Dr. Pancoast was a member and for one term President of the Philadelphia County Medical Society; a member of the State Medical Society, American Medical Association, and the Philadelphia Academy of Surgery. He was Surgeon to the Charity and Philadelphia Hospitals. Possessed of very agreeable manners, he was very popular with students and with members of the medical profession who came under his instruction.

PERRY H. MILLARD, M.D.

Born 1848. Died February 1, 1897.

Dr. Perry H. Millard was born in the State of New York in 1848. He received his early education at the Ogdensburg Educational Institute, and his Medical Degree from Rush Medical College, of Chicago, in 1872. Removing to St. Paul, Minn., he took an active interest in matters relating to medical education in the State and to the organization and development of the Medical Department of the University of Minnesota. Through his exertions is due largely, if not entirely, the enactment of the statutes relating to qualifications for the practice of medicine in the State, and as a member of the Association of Medical Colleges of the United States he was an earnest advocate of higher medical education.

He was Dean and Professor of the Principles of Surgery and of Medical Jurisprudence in the University of Minnesota. His contributions to medical science appeared in the medical journals, and were of value.

J. EDWIN MICHAEL, M.D.

Born May 13, 1848. Died December 7, 1895.

Dr. J. Edwin Michael was born near Michaelsville, Harford County, Md., May 13, 1848. His early life was spent on his father's

farm near the Chesapeake Bay, and his preliminary education was received at St. Timothy's Hall, Md., and at the Newark Academy, Delaware. He graduated from Princeton College in 1871, and in 1873 he received his degree in medicine from the University of Maryland, and passed the subsequent year in attendance upon hospital clinics and private courses of study on the Continent of Europe.

On his return to Baltimore in 1874 he was appointed Demonstrator of Anatomy in the University of Maryland, and in 1880 was elected Professor of Anatomy and Clinical Surgery. In 1890 he was transferred to the Chair of Obstetrics.

He was President of the Clinical Society of Maryland and of the Medical and Chirurgical Faculty of Maryland, and also a member of the American Medical Association and of the various local societies of his city. He was a very popular lecturer and teacher, and enjoyed a high rank as an operating surgeon.

THE GROSS STATUE.

History of the Statue.

At the annual meeting of the American Surgical Association in 1891 President C. H. Mastin, in his annual address, recommended "that a committee from the Association be appointed to confer with the friends and admirers of Dr. Gross, and with the medical profession of the whole country, to determine the best method to be adopted to secure the requisite amount for the erection of a monument either of marble or of bronze."

The Committee on the President's Address recommended that the President be empowered to appoint a committee to carry out his suggestions as to the erection of a suitable monument to commemorate the distinguished services of the founder of the Association, Prof. Samuel D. Gross, the Association concurring in the report. The President appointed a committee of twenty-six, with Dr. J. R. Weist, Chairman, and Dr. C. H. Mastin, Secretary. The committee immediately issued circulars addressed to the profession of the whole country, soliciting funds for the prosecution of the work assigned it.

At the meeting of the Association in 1892 a partial report was made, and the committee continued.

At the meeting in 1893 a full report of the work of the committee was made. In the report it was stated that a proposition had been made by the Alumni Association of the Jefferson Medical College, Philadelphia, to unite with the committee in raising the funds necessary to complete the monument. By a resolution of the Association the committee was continued, its work already done indorsed, and authority given "to prosecute the work in such a manner as it deemed best for the success of the enterprise."

Under the authority given, the proposition of the Alumni Association of Jefferson Medical College, Philadelphia, was accepted, and Dr. W. W. Keen added to the committee to represent the Alumni Associa-

tion. A sufficient sum having been collected to justify its action, the committee invited three artists to enter into a competition for a design for the monument; one of them withdrew from the competition; from the other two three models were received and placed on exhibition at the Pennsylvania Academy of Fine Arts, where they were carefully inspected by the President of the Academy, the Professor of Painting in the Academy, Mr. St. Gaudens, sculptor, of New York, Dr. Orville Horwitz and Mr. A. Haller Gross, representing the family, and Dr. W. W. Keen, representing the committee. Photographs of the models were also examined by the other members of the committee—Drs. J. R. Weist and C. H. Mastin. A model submitted by Mr. A. Sterling Calder met the approval of all those who examined the models, and a contract was entered into with him to model a heroic statue, nine feet high, to be cast in bronze and erected in the City of Washington, the statue to be completed within two years. He proceeded to Europe, and the statue was cast from standard United States bronze in the city of Paris.

Through the strenuous exertions of the committee, and of many of the Jefferson Alumni and friends of Dr. Gross, and Senators Morgan and Quay and Representatives Adams and Clarke, a bill was passed by Congress and signed by the President, appropriating the sum of fifteen hundred dollars for the granite pedestal ten feet high. The statue stands in the city of Washington on a site selected by the Superintendent of Public Buildings and Grounds, Col. J. M. Wilson, United States Army, on the driveway between the Army Medical Museum and the National Museum, a point where it will be seen by many thousands annually, and especially by medical men who will visit the Army Medical Museum.

The statue was unveiled by the American Surgical Association and the Alumni Association of the Jefferson Medical College on May 5, 1897, during the Fourth Triennial Meeting of the Congress of American Physicians and Surgeons. The American Surgical Association appointed Dr. C. H. Mastin to present the statue and Dr. W. W. Keen to give the address. The Secretary of War designated Gen. George M. Sternberg, Surgeon-General United States Army, to receive the statue on behalf of the Government. The following was the

Order of Exercises.

1. Prayer by Rev. B. L. Whitman, D.D., President of Columbian University, Washington, D.C.
2. Presentation of the statue by Claudius H. Mastin, M.D., LL.D., of Mobile.
3. Unveiling of the statue by Miss Adèle Horwitz, of Baltimore, a granddaughter of Professor Gross.[1]
4. Reception of the statue on behalf of the Government by Brigadier-General George M. Sternberg, M.D., LL.D., Surgeon-General United States Army.
5. Address by W. W. Keen, M.D., LL.D., of Philadelphia.

[The accompanying illustration is from a photograph furnished by the courtesy of Col. D. L. Huntington, U. S. A. The building seen in the background is the Army Medical Museum.]

[1] On account of the rain, this part of the programme was omitted.

ADDRESS ON THE UNVEILING OF THE GROSS STATUE.

By CLAUDIUS HENRY MASTIN, M.D., A.M., LL.D.,
MOBILE, ALA.

SIR: This is an occasion of unusual interest, and in the assembly here to-day convened you behold no ordinary gathering of ordinary men. It is the Congress of American Physicians and Surgeons, an Association which is composed of the leaders of medical and surgical thought in America. They have come to honor the memory of one of their illustrious dead, and in paying a tribute to departed greatness they testify to the world their appreciation of the work which he has done.

As you are aware, sir, the late Prof. Samuel David Gross was a man of distinguished ability in the profession of medicine, and, as such he was justly entitled to the highest distinction which could be conferred upon his memory by his co-laborers.

His life and character furnish an example which is worthy the emulation of the youth of the land, and hence we desire to place a lasting memorial of his greatness in the capital city of our country.

Born of German parentage in the mountains of Eastern Pennsylvania, he inherited from his ancestry those sterling qualities of head and heart which characterize the race from which he sprang—qualities so essential to great deeds and invaluable in the contest for "the survival of the fittest."

We find him in early youth a poor boy, without the prestige of a name or the influence of family or fortune; of studious habits, ambitious promptings, struggling along the toilsome pathway of a young practitioner of medicine.

We note how he surmounts obstacle after obstacle which impede his progress to the goal of his ambition. Adversity came to him, and adversity was thrust aside; nothing daunted, he gathered anew fresh energy and pressed onward in his high career. Guided by the star of destiny which shaped his course his own indomitable spirit brought to him the fixed persuasion of success!

Ere he had reached the full meridian of life he had become a Master in Surgery. Endowed by nature with a strong intellect, which he carefully cultivated, he used it to the noble end of ameliorating human suffering, and thereby lengthening the span of human life.

A philanthropist in the true sense of the term, he reached the highest position hitherto attained by any American physician. He was bold of assertion, relying upon the rectitude of his purpose; he was fearless of opinion, but with it all, without arrogance, he was charitable.

Enjoying a close intimacy with the wise and the learned all over the world, he was crowned with the highest degrees of almost every foreign university.

His exact knowledge of surgical science enabled him to make important changes in its principles, thereby enlarging the scope of its influence; he added to its literature by stimulating research!

An exhaustive collaborator, he became a painstaking compositor; a voluminous writer, he was the author of many books, which, translated in various tongues, have become standard wherever the art of surgery is known or Hippocratic medicine taught or practised.

Having reached the front rank of his profession—a peer among many—he accepted the sceptre, and without ostentation he placed upon his own brow the Diadem of American surgery.

He lived beyond the limit of man's allotment, when full years, full of honor, beloved at home and revered abroad, he rounded up his great mission and rested from his labors on the sixth day of May, in the year 1884.

Now, after life's fitful fever, on the Western bank of the Schuylkill, in Woodlands' holy precincts, repose his ashes—ashes which make it holier; dust, which is, even itself an immortality.

Such in brief is the outline of a life, which, framed in the prodigality of Nature, was not intended for an age, but for all time—a life of which we can truly say:—

"Finis Coronat Opus."

In acknowledgment of his great deeds in the profession, a movement was inaugurated in the autumn of 1891 by the American Surgical Association, of which he was the founder and the cherished idol, to erect a monument commemorative of his life and character. The initiatory steps having been taken, the Alumni Association of the Jefferson Medical College of Philadelphia asked permission to unite in the enterprise. A joint committee having been appointed, the requisite amount of money was speedily collected, not alone from the

profession, but also from many admiring friends, both at home and abroad; and it is to their united efforts that we are indebted for the funds which have enabled us to complete the work in the short space of time since it was begun.

We desire publicly to acknowledge our indebtedness to Senators Quay and Morgan, as well as to Representatives Adams of Pennsylvania and Clarke of Alabama, for services which they rendered in securing the approval of the Government of our wish to erect the statue in the City of Washington, and also for the liberal appropriation made for the massive pedestal upon which the statue rests.

The question arising as to the proper place at which such a statue should be erected, the consensus of opinion was that the only proper locality would be in the National Capital.

His name and fame having passed beyond the confines of the seas, and hence being both national and international, we asked permission of the General Government to place it amidst these classic shades, and to group it with the other statues of the nation's illustrious dead—her heroes whose names have been graved upon the tablets of their country's glory—Statesmen whose words of wisdom in the council have directed the affairs of State; Warriors whose deeds of valor by flood and field have made impregnable the bulwarks of the nation's safety; Jurists who have preserved unsullied the purity of the ermine; Philosophers who have grappled the lightning's fiery wing, and, holding it in dumb submission to the will of man, dispatch it as a messenger of thought to the uttermost ends of the earth.

The statue which we unveil to-day is not that of a statesman, neither a soldier, nor a jurist, but it is one of a Medical Philosopher—one whose mission was holier than either, because it was to follow in the steps of Him who was the Great Physician, that Divine Man whose whole ministry was one of mercy, and who, after "curing all manner of diseases," finished its majestic self-denials in the reconciliation of the Cross.

By adding a physician to this group of celebrities, we show that he was equal to them in his country's favor; and in placing it here, we knew that pilgrims from every clime to which the broad sun turns its universal fires, will see, when they visit this land of liberty, what our appreciation is of one who has done so much for the cause of human suffering, and, challenging our exclusive appropriation of his fame, claim it in the name of all nations and of all times as the glorious heritage of a common humanity!

To me, sir, has been delegated the honor of presenting this statue to you, the authorized representative of the United States Government, and through you to the people thereof. In obedience to instructions, I here to-day, under the protecting ægis of the Goddess of Liberty which surmounts the dome of yon stronghold of freedom in the Western Hemisphere, deliver into your keeping this figure, the likeness and personification of one who is sacredly embalmed in the hearts and memories of his professional brethren.

It is a work of art; the handicraft of one of our own countrymen, Mr. Alexander Sterling Calder, a young artist of Philadelphia, who went abroad for the purpose, and has deftly reproduced in bronze the features and the form exact. It is firmly fixed upon that granite base, which the Government itself has had prepared for its reception, thus making it enduring—so enduring that when the ages which are to come shall roll by, and future generations of freeborn Americans rise up to people these fair lands, they will find, still standing where we leave it to day, the statue of America's Great Surgeon

SAMUEL DAVID GROSS.

"A lofty name,
A beacon light and a landmark on the cliffs of Fame."

ADDRESS ON RECEIVING THE STATUE.

By GEORGE M. STERNBERG, M.D., LL.D.,
SURGEON-GENERAL U.S.A.

SIR: The pleasant duty has been assigned to me of accepting for the National Government this statue of the great surgeon whose name for many years occupied the foremost place among the surgeons of the Western Continent, and whose fame will be perpetuated by this tribute to his memory, erected by the American Surgical Association and the Alumni Association of the Jefferson Medical College of Philadelphia.

I am not here to pronounce a eulogy on Professor Gross or to review his achievements as a surgeon. This task has properly been assigned to his distinguished successor in the Chair of Surgery at the medical college with which he was so long associated as a teacher. But I think I give voice to the unanimous sentiment of the profession when I say that no man living or dead is better entitled to stand before future generations as a representative of American surgery in the nineteenth century. It is true that many surgeons whose reputation scarcely extends beyond the city in which they live are to-day performing with success operations which Gross would have considered unjustifiable on account of the danger to life attending such attempts before the introduction of antiseptic and aseptic methods. But many of these successful surgeons received their first lessons from the great master whose statue is before us, and all realize that if Gross had lived long enough to have become familiar with the technique and results of these new methods, his skill and experience would have enabled him to accomplish surgical feats which he would not have considered possible when he was in the prime of life and vigor.

It appears to me to be especially appropriate that this statue of our great American surgeon is placed here in close proximity to the Army Medical Museum and Library building, which contains a library in which, no doubt, can be found all of his own valuable contributions to surgical literature, and which is a storehouse of information for all those who, like him, combine with the skill and boldness of the sur-

geon an ardent desire for the advancement of the profession, and indefatigable industry in the literary researches required of one who has obtained prominence as a teacher and leader in any branch of medicine.

In the same building is the extensive collection of pathological specimens in the Army Medical Museum, a collection in which Professor Gross took the deepest interest. Very many of the specimens collected during the Civil War show the results of wound-infection, and serve rather to illustrate the disastrous consequences of methods which had the approval of surgeons of that day than as examples of successful surgery.

Certainly the greatest achievements of modern surgery are those which relate to the saving of life and limb by conservative operations and the exclusion from wounds of those ubiquitous micro-organisms which in the past have destroyed more lives than have bullets or sabres. Professor Gross lived to see the dawn of the new light, and in imagination I see him before me, his expressive features illuminated by the anticipation of future triumphs to be achieved by American surgeons who should follow the paths he had laid out and the methods he had taught with the additional advantages afforded by following Lister's initiative in waging a merciless warfare upon the invisible germs of wound-infection.

In accepting, as I do, for the Government this tribute of American surgeons to a revered master, I beg leave to congratulate the committee which has had the matter in charge upon the successful completion of their labor of love. No doubt they have found the task imposed upon them beset with many difficulties, and the success achieved has been at the expense of much solicitude, extensive correspondence, and persistent personal effort, especially on the part of the chairman of the committee. To him and his co-workers, and to all of the subscribers to the monument fund, the present occasion must be one of great satisfaction, for they cannot fail to realize that they have accomplised a task worthy of their efforts, and I believe that I am justified in conveying to them the thanks of the profession. It is eminently fit that this statue should have been erected here in a public park at the National Capital, where for centuries to come those who visit this spot may read the name of Gross and learn that during the first century of American Independence there lived a great surgeon of that name, whose character and achievements commanded the admiration of his contemporaries.

ADDRESS.

By WILLIAM W. KEEN, M.D., LL.D.,
PHILADELPHIA.

FELLOWS OF THE AMERICAN SURGICAL ASSOCIATION; MEMBERS OF THE ALUMNI ASSOCIATION OF THE JEFFERSON MEDICAL COLLEGE, AND FRIENDS: Go with me, your spokesman, to-day to the Woodlands Cemetery—that "God's Acre" or "Court of Peace," as the Germans so poetically call it—which holds the dust of so many of the best dead of Philadelphia. Upon an urn there treasured you will read the following:

IN MEMORIAM.

Within this urn lie the ashes of

SAMUEL D. GROSS,

A Master in Surgery.

His life, which neared the extreme limits of the Psalmist, was one unbroken process of laborious years.

He filled chairs in four Medical Colleges, in as many States of the Union, and added lustre to them all.

He recast Surgical Science, as taught in North America, formulated anew its principles, enlarged its domain, added to its art, and imparted fresh impetus to its study.

He composed many Books and among them

A SYSTEM OF SURGERY,

Which is read in different tongues, wherever the Healing Art is practised.

With a great intellect, carefully trained and balanced, he aimed with undivided zeal at the noble end of lessening human suffering and lengthening human life, and so rose to the highest position yet attained in science by any of his countrymen.

Resolute in truth, he had no fear; he was both tolerant and charitable.

Living in enlightened fellowship with all laborers in the world of Science, he was greatly honored by the learned in foreign lands, and deeply loved at home.

Behind the Veil of This Life There is a Mystery Which He

Penetrated on the

SIXTH DAY OF MAY, 1884.

HIS MEMORY

Shall exhort and his Example shall encourage and persuade those who come after him to emulate deeds which, great in themselves, were all crowned by the milk-white flower of

A STAINLESS LIFE.

Who and what was the man of whom this was said?

Samuel David Gross was born near Easton, Pennsylvania, July 8, 1805, and died in Philadelphia May 6, 1884, having nearly completed his seventy-ninth year.

His early years, under the wise training of a good mother, to whose memory he rightly pays a just tribute, were spent amid the rustic labors and healthful pleasures of a Pennsylvania farm. This gave him a strong and vigorous body, without which he never could have performed a tithe of the labor which pre-eminently distinguished his long life. Before he was six years old he determined to be a surgeon, and early in his professional studies to be a teacher. Yet when he was fifteen he knew scarcely any English. Brought up among the sturdy, honest, laborious Pennsylvania Dutch, he could speak that curious English-German. But his English, of which he became so fluent a master, and even pure German, which he began to study at the same time, were learned almost as foreign tongues and as a result of his appreciation at that early age of his need for a better and wider education. Even a still more striking evidence of the early development of the innate strength of his character and indomitable will is a story told in his autobiography. While a boy he became expert in playing cards; but finding he was becoming so much fascinated by them that he replayed his games in his dreams, he resolved—fancy this in a boy not yet fourteen!—to abstain from the game for twenty years—a vow he religiously fulfilled.

At seventeen he began the study of medicine as the private pupil of a country practitioner, but after learning some osteology with the aid of that tuppenny little compend, Fyfe's *Anatomy*, and a skeleton, he gave up in despair, for again he found his intellectual tools unequal to his work. The little Latin he had was insufficient, and to understand the technicalities of medicine, Greek was a *sine qua non*. "This," he says, "was the turning-point of my life. . . . I had made a great discovery—a knowledge of my ignorance, and with it came a solemn determination to remedy it." Accordingly he stopped at once in his medical career and went to an academy at Wilkes-Barre. He studied especially Latin and Greek, the latter by the use of Schrevelius's lexicon, in which all the definitions were in Latin, and Ross's grammar, constructed on the same principle. But to a master will like his such obstacles were not insuperable. To Greek and Latin, English and German, later years added also a knowledge of French and Italian.

At nineteen he began the study of medicine again—a study in which for sixty years his labors never for a moment ceased or even relaxed.

In 1828, at the age of twenty-three, he took his degree in the third class which was graduated from the Jefferson Medical College. He opened an office first in Philadelphia, but soon removed to Easton. Nothing is more characteristic of the man than that, while waiting for practice, he spent hours daily in dissecting in a building he erected at the back of his garden, and provided himself with a subject by driving in a buggy all the way from Easton to Philadelphia and back with a gruesome companion; wrote a work on descriptive anatomy, which, however, he never published, and in eighteen months after graduation had translated and published Bayle and Hollard's *General Anatomy;* Hatin's *Obstetrics;* Hildebrand on *Typhus*, and Tavernier's *Operative Surgery*—works aggregating over eleven hundred pages. His motto was indeed "*Nulla dies sine linea.*" His "stimulus" he himself says, "was his ambition and his poverty."

In 1833, five years after his graduation, he entered upon his career as a teacher—a career which continued for forty-nine years, until within two years of his death. This took him first to Cincinnati as Demonstrator of Anatomy in the Medical College of Ohio. Those of my audience who left Cincinnati yesterday will be amused to learn that by stage, canal, and primitive steamboat, it took him thirteen days to reach the Queen City; and all of you will admire the pluck and courage of the young man when I add that his total worldly goods on reaching there were one hundred dollars in his purse, a wife and two children in his family, but also in his breast a heart ready to grapple with any difficulties and a determination to conquer them all.

In 1835 he became Professor of Pathological Anatomy in the Cincinnati Medical College, where he was a colleague of Daniel Drake, Willard Parker, and James B. Rogers, one of the famous four brothers, with a second of whom—Robert E.—he was later a colleague in the Jefferson.

His book on the *Bones and Joints* had appeared in 1830, and next, as a result of four years' study and teaching, his *Elements of Pathological Anatomy* was published in 1839. It is strange to think that in a then small Western town in America a young teacher in a new medical school should have published the first book in the English language on Pathological Anatomy. No wonder, then, that it brought him fame and practice; that its second edition made him a member of the Imperial-Royal Society in Vienna; and that, thirty years afterward,

Virchow, at a dinner he gave to its then distinguished author, should show it as one of the prizes of his library.

In 1840 he went to the University of Louisville as Professor of Surgery, and, excepting one year when he was Professor of Surgery in the University of the City of New York, he remained there for sixteen years, happy in his family, his students, his flowers, and his generous hospitality. He and his colleagues—Drake and Austin Flint—soon made it the most important medical centre in the West, and he was in surgery the reigning sovereign. While there he published, in 1851, his work on the *Urinary Organs*, and in 1854 another pioneer work, that on *Foreign Bodies in the Air-Passages*. His fame had become so great that he was invited to the University of Virginia, the University of Louisiana, the University of Pennsylvania, and other schools. But he was steadfast to Louisville until his beloved Alma Mater called him to the chair just vacated by Mütter. From 1856, when in his Introductory he said, "whatever of life and of health and of strength remain to me, I hereby, in the presence of Almighty God and of this large assemblage dedicate to the cause of my Alma Mater, to the interest of medical science, and to the good of my fellow creatures," until he resigned his chair in 1882—nay, until his death in 1884—this was absolutely true. Even when the shadows of death were thickening he corrected the proof-sheets of two papers on "Wounds of the Intestines" and "Lacerations Consequent upon Parturition," his last labors in the service of science and humanity.

Three years after he entered upon his duties at the Jefferson he published his splendid *System of Surgery*—a work which, though in many respects its pathology and its practice are now obsolete, is a mine of information, a monument of untiring labor, a text-book worthy of its author, and which has been the companion and guide of many generations of students. It was translated into several foreign tongues and passed through six editions, the last appearing only seventeen months before his death. That even when verging toward fourscore he should have been willing to throw aside all his strong prejudices and accept the then struggling principles and practice of Listerism shows the progressive character of his mind and his remarkable willingness to welcome new truths.

From his removal to Philadelphia until his death, twenty-eight years later, his life can be summed up in a few sentences: daily labor in his profession, editorial labor without cessation for some years in managing the *North American Medico-Chirurgical Review*, the successor of the

Louisville *Medical Review*, of which he had also been the editor; article after article in journals; address after address; twenty-six annual courses of lectures on surgery to thousands of students; labors without ceasing until he wrapped the drapery of his couch around him and calmly passed away.

In reviewing his life we may fittingly consider it from the standpoint of the surgeon, the author, the teacher, and the man.

As a surgeon he was painstaking, thorough and careful in his investigation of a case, skilful as an operator, and, having so vast an experience and equally extensive acquaintance with the wide literature of his profession, he was scarcely ever perplexed by the most difficult case and rarely at a loss as to the proper course to pursue in the most unexpected emergencies.

He was a practitioner of the old school, who always mingled medicine with surgery, and attributed much of his success in the latter to his experience in the former. In theory he sometimes clung to beliefs, which, in practice, he abandoned. In one of his later papers, "A Lost Art," and in his lectures, he still advocated blood-letting; but in the nearly twenty years in which as a student, an assistant in his clinic, and a quiz-master I saw much of his practice, I only remember two cases in which he actually bled his patients.

His influence on the profession was marked and wholesome. For many years he was almost always at the annual meetings of the American Medical Association and the American Surgical Association, was looked up to in both as the Nestor of the profession, and his papers and his wise words of counsel moulded both the thought and the action of his brethren to a notable degree. He founded two medical journals, was the founder of the Pathological Society of Philadelphia and of the Philadelphia Academy of Surgery, the founder and first president of the American Surgical Association, and the first president of the Alumni Association of the Jefferson Medical College. It is peculiarly fitting, therefore, that these last two associations should unite to-day in erecting and unveiling the bronze statue of one who did so much for them and whom they rightly delight to honor. All who knew his tall, manly figure and his fine face will agree that it is a speaking likeness, both in pose and feature. Could I only get a glimpse of the right hand which holds his familiar scalpel I would recognize the man. *Ex pede Herculem! Ex manu Gross!*

As an author, his chief characteristics were untiring industry, comprehensiveness, methodical treatment of his subject, and a singular

felicity of style, especially for one who acquired English so late and with difficulty. In fact, through life his speech, by a slight, though not unpleasant accent, always betrayed his German descent.

He "blazed" more than one new "trail" in the forests of surgical ignorance. In the early part, and even in the middle of this century, it was rare for Americans to write medical books. The most they did was either to translate a French or a German work or to annotate an English one. He was one of the earliest to create an American medical literature of importance, and his works on the *Urinary Organs*, on *Foreign Bodies in the Air-Passages*, and his text-book on *Surgery* gave a position to American surgery abroad which we can now hardly appreciate; while, as already related, his *Pathological Anatomy* was the very first work in the English language on that most important branch of medicine.

His experiments and monograph on *Wounds of the Intestines* laid the foundation for the later studies of Parkes, Senn, and other American surgeons, and have led to the modern rational and successful treatment of these then so uniformly fatal injuries. He first advocated abdominal section in rupture of the bladder, the use of adhesive plaster in fractures of the legs, amputation in senile gangrene, and the immediate uniting of tendon to tendon when they were divided in an incised wound. Had he lived but a year or two longer bacteriology would have shown him that scrofula was of tubercular origin, and not, as he so firmly believed and vigorously taught, a manifestation of hereditary syphilis.

That his eminence as an author should have met with recognition from scientific organizations and institutions of learning is no cause of surprise. It made him the president of the International Medical Congress of 1876, a member of many of the scientific societies of Europe as well as of America, and won for him the LL.D. of the University of Pennsylvania, and I believe the unique honor in America of having had conferred upon him the highest degree of all three of the leading universities of Great Britain—Oxford, Cambridge, and Edinburgh. Indeed, it is both significant and pathetic to note that he laid down his pen just after recording in his autobiography the announcement of the honor which the University of Edinburgh intended to bestow upon him at its tercentenary celebration.

As a teacher, I can speak both with personal knowledge and enthusiasm. I can see his tall, stately form, his handsome face, his glowing features, his impressive gestures. He was earnestness itself. Filled to

overflowing with his subject, his one desire was to impart to us as much of the knowledge he possessed as our young heads could hold. Repetition did not blunt the novelty nor time lessen the attraction of his theme. It always seemed as if he were telling us for the first time the new story of the beneficent work that surgery could do for the injured and the suffering. His whole heart was in his work. Especially did he inculcate the principles of surgery, for he was convinced, and rightly, that one who was thoroughly imbued with these could not go far wrong in his practice.

His own statement of one of the qualifications of a teacher is so true yet so often forgotten that, in spite of its mixed metaphor, I will quote it: "A teacher should be bold and decided in his opinions; not too positive, but sufficiently so to be authoritative. The student cannot judge for himself. The knowledge that is placed before him must be, so to speak, well digested for him; otherwise it will stagger and bewilder, not instruct him." His sense of the heavy responsibility of the teacher is well shown by the following from his autobiography: "Nothing was more offensive to me than applause as I entered the amphitheatre, and I never permitted it after the first lecture. I always said, 'Gentlemen, such a noise is more befitting a theatre or a circus than a temple dedicated not to Æsculapius, but to Almighty God, for the study of disease and accident, and your preparation for the great duties of your profession. There is something awfully solemn in a profession which deals with life and death, and I desire, at the very threshold of this course of lectures, to impress upon your minds its sacred and responsible character, that you may be induced to make the best possible use of your time, and conduct yourselves in a manner worthy of the dignity of Christian gentlemen.'"

The value of recitations in a medical course I fully appreciate and indorse. They will occupy in the future a much larger place in our medical schools than they now do. But I am equally convinced that such a voice, such a presence, such an impressive, earnest lecturer will never lose their powerful influence nor their place in instruction.

As a man, he was beautiful in his relations with his family, who were devoted to him with an affection that was unusually strong; upright in all his dealings, and despising cant and pretense and anything unworthy a true gentleman. Few men were more widely known in and out of the profession, and few ever had the good fortune to know intimately so many distinguished people of both continents. Wherever he

was known he was respected, and by those who knew him intimately he was beloved.

Such, then, was the man whom we are gathered to-day to honor. The American Surgical Association, the Alumni Association of the Jefferson Medical College, and a few friends who have gladly united with us in this service of affectionate remembrance, have presented his statue to the people of the United States, to stand forever in our beautiful capital city as a mute yet eloquent evidence of our esteem for his personal worth and his professional attainments.

It is strange that the human race has failed so grievously to recognize publicly its great medical benefactors. Mr. Lecky, in his last remarkable book, in speaking of the rewards of genius in Great Britain, after enumerating the chief of the extraordinary and beneficent achievements of medical men in the present century, says, "England may justly claim a foremost place in this noble work, and many of her finest intellects have been enlisted in its service. In no single instance has this kind of eminence been recognized by a peerage. It is clearly understood that another and a lower dignity is the stamp of honor which the State accords to the very highest eminence in medicine and surgery—as if to show in the clearest light how inferior in its eyes are the professions which do most to mitigate the great sum of human agony to the professions which talk and quarrel and kill." (*Democracy and Liberty*, i. 429.) And yet Jenner almost saved England from extinction, and Simpson and Lister have done far more to mitigate the terrors of surgery and the pangs of maternity, to save life, and to bring health and happiness to the human race than Marlborough and Wellington and Nelson have done to destroy life and bring sorrow and pain and rapine and misery.

It is pleasant to record that England has atoned, with the opening of this year, for such long-continued neglect. In making Sir Joseph Lister the first medical peer she has conferred less honor upon Lord Lister than upon herself.

The statue of Marion Sims, not long since erected in New York, and this one of Samuel D. Gross, let us hope, are the beginning of a similar recognition of beneficent genius in our own land. Go through the broad streets of this beautiful city, and in its circles and parks and squares you will find, with singular exceptions, only the statues of statesmen and warriors—men who deserve, we all agree, their well-won honors and immortality. But, truly, "Peace hath her victories no less renowned than those of war." Though its heroes are not, it may be,

portrayed in marble or bronze, they are enshrined in the grateful hearts of mankind, immortal in literature, even the humblest of such toilers as the Gideon Grays and the Weellum Maclures that cheer and brighten the world.

And were the soldiers, whose statues one may see everywhere around us, the sole possessors of bravery? In 1832, that most dreaded of all scourges, Asiatic cholera, for the first time broke out all over this country with the greatest virulence. Easton was only eighty miles from New York, and the citizens, in terror lest the dread disease would reach their own town, appointed a young, intrepid surgeon to visit New York and learn what he could for their benefit. When others were fleeing in frightened thousands from the pestilence Gross bravely went directly into the very midst of it, reaching New York when the epidemic was at its very height. In that then small and half-depopulated town 385 persons died on the very day of his arrival—and he stayed there a week in a hot July, visiting only its hospitals and its charnel-houses. What call you that but the highest type of bravery?—a bravery which Norfolk and Mobile and Memphis have since seen repeated by scores of courageous physicians ready to sacrifice their lives for their fellowmen with no blare of trumpets, no roar of cannon, no cheer of troops, no plaudits of the press! No battlefield ever saw greater heroes; no country braver men!

Yonder statue of Joseph Henry has stood alone for too many years. We have to-day unveiled its worthy companion. Both of them are memorials of men great in science, whose lives were devoted to the good of their fellow creatures, to saving life, adding to human comfort, lessening pain, promoting knowledge, cheering the sick, and assuaging even the very pangs of the dying. We do well thus to honor in imperishable bronze the men who have won these victories of peace! To no one can the words of the blessed Master apply with greater force than to the kind surgeon whose time and thought and talents are given to humanity, and, above all, to the poor, with no payment but the grateful look of returning health and rescued life and that inward satisfaction which far surpasses all the wealth of the Orient—"Inasmuch as ye have done it unto one of the least of these, my brethren, ye have done it unto Me."

One of the earliest operations under ether at the Massachusetts General Hospital

ADDRESS OF THE PRESIDENT.

THE INFLUENCE OF ANÆSTHESIA ON THE SURGERY OF THE NINETEENTH CENTURY.

By J. COLLINS WARREN, M.D., LL.D.,
BOSTON.

GENTLEMEN: In selecting a topic for the annual address before such a body as this, it seemed to me desirable that the opportunity should not be lost to refer to the great event, the fiftieth anniversary of which has so recently been celebrated—an event which is so indelibly associated with American surgery, but one in which the whole world joined with us in commemorating.

As one of the staff of surgeons whose predecessors played so prominent a part in the introduction of anæsthesia, I feel it incumbent on me to recall to you today some of the great changes which it helped to bring about.

Let me turn your attention first to the century which preceded anæsthesia. It is difficult to realize the crude state of surgical knowledge and technique and the relation it still bore to medicine even so late as the eighteenth century. In the previous century it was quite beneath the dignity of a medical man of standing to do any surgical work.[1] Capital operations were, however, performed, for we read that Abraham Cyprianus, of Amsterdam, toward the end of the seventeenth century had performed lithotomy 1400 times, and had also done abdominal sec-

[1] Fr. Hoffman: "Der medicus soll nicht schneiden, brennen, noch Pflaster auflegen, weil es wieder die Würde eines medici nationalis ist, denn es sind fast überall Barbierer, Bäder, und Steinschneider zu haben." Politischer Medicus, S. 57.

tion and had championed radical operations for hernia. Amputations were still performed in a very crude way, and in spite of Paré's teachings of one hundred years before the management of hemorrhage appears to have been of a most primitive character. They were confined to fingers and toes, the forearm and the leg, amputations above the elbow or knee being regarded as a very dangerous procedure. The introduction of the tourniquet by Petit, in 1718, brought with it a greatly improved technique and made possible the selection of a point of election for amputations and the more general use of the ligature, and secured the permanent abandonment of the cautery and styptics.

The prejudice against surgery, however, still prevailed, and those who continued to advocate a union of surgery with medicine lost caste with their associates. The students in Freiburg threatened to mob von Wuthwehr, who, in 1774, pointed out the necessity for a union of surgery with medicine. Toward the middle of this century schools of surgery were established for the benefit of the armies, and more attention was paid to instruction in this department at the universities. It is recorded, however, that in Germany at this period it was still considered an important part of the duties of the military surgeons to shave both privates and officers. Finally the Academy of Surgery was founded in 1731. The degrading association of barbers and surgeons was abolished in 1743 at Paris by an edict, and the example was speedily followed, in 1745, by a similar Act in the English Parliament. Freed from this galling servitude, surgery became a separate and distinct branch, to be ever afterward studied and cultivated by educated members of the profession.[1] In England particularly, owing to the more careful attention to the study of anatomy, the technique of surgical operations greatly improved, and many of the methods of operating still in use today trace their origin to this period, such as operations for stone, the removal of tumors, and amputations.

Pott undertook to divest surgery of much of its horrors.

[1] Dunglison: History of Medicine.

A prophetic utterance of Pott in one of his books is interesting: "Many and great are the improvements which the chirurgic art has received within the last fifty years; and much thanks are due to those who have contributed them; but when we reflect how much remains to be done, it should excite our industry rather than our vanity. Our fathers thought themselves a great deal nearer to perfection than we have found them to be; and I am much mistaken if our successors do not in more instances than one wonder both at our inattention and ignorance."

The means of teaching surgery in Paris was limited, owing to the bad condition of the hospitals. In the Hôtel Dieu the operating theatre was in the St. Jerome Ward, where more operations were said to be performed than in any hospital in Europe. It was placed almost directly over the dead-house, the odors of which were quite perceptible. This ward accommodated twenty beds and an out-patient department. In some of the adjacent wards the walls were soiled with expectorations and the floors with the discharges of the patients. The mortality in this hospital before the Revolution was one death to every 4.5 patients who entered. This included many persons who were hardly ill, the insane, and pregnant women. It was the rule that every case of amputation of a limb died.

In 1787 a school of practical surgery was founded by Desault, and the union of the teaching bodies in medicine and surgery was effected in 1794, when the Écoles de Santé were established. (These names were soon changed to the Écoles de Médecine.)

In England at this period surgery was in a much better condition. This was owing to the fact that the teaching was done largely in private schools and by men of worldwide reputation, for these were the days of the Bells and Hunter. Much as the latter did for anatomy, pathology, and surgery, the prejudices of early education still clung to him. In 1753 Hunter was advised to study medicine, rather than surgery, as a higher branch of the healing art, and he continued to regard an operation as a tacit acknowledgment of the insufficiency of medicine.

The horrors of surgery without anæsthetics caused even surgeons themselves to look upon operative surgery as the lowest, poorest side of their profession. An operation was attended with almost the formality of an execution. The hardiest of them are described as steeling themselves to the duty of operating. John Hunter spoke of operations as "humiliating examples of the imperfectness of the science," and pictures the operating surgeon "as an armed savage." He says: "No surgeon should approach the victim of his operation without a sacred dread and reluctance, and should be superior to that popular *éclat* generally attending painful operations, often only because they are so."

Abernethy and Cheselden regarded operations as the reproach of surgery. Abernethy felt the strain of operating keenly; it was an added hardship for him to work on a patient who bore pain with fortitude. It is reported that he felt such repulsion to operations that he regarded them as having no place in surgery as a science.

An anecdote illustrating his feeling is related by his biographer. He was performing a severe operation on a woman. He had, as was usual, given her some words of encouragement before he began, and the patient was bearing the pain with great bravery. After suffering some seconds she said earnestly, "I hope, sir, it will not be long."

"No, indeed," replied Abernethy, with great feeling; "that would be too horrible."

Cheselden is said to have seldom slept the night before an operation, so much did he dread it; yet he was always cool and firm and dextrous in its performance.

It is probable that the dread of patients was not confined to the operation, for in early days the after-treatment was of the most torturing description. Every flap of skin, instead of being reunited, was cut away; every open wound was dressed as a sore, and every deep one was plugged up with a tent lest it should heal. No attempt at first intention was made. Long tents were thrust into wounds of the neck and cheek until the neck and head swelled enormously. Even in compound frac-

tures dressings were thrust between the ends of broken bones, as if they had been afraid of the formation of callus.[1]

At the opening of the century the improvement of the technique of the French school was very noticeable. This was due not only to the organizing powers of Napoleon, but to the development of military surgery. The influence of such work as was done by Larrey upon French surgery must have been enormous. It is said that Larrey performed alone in one day 200 amputations after the battle of Moskowa. His operations were not confined to amputations alone. His memoirs contain accounts of double amputations of the thigh, resection of the head of the humerus, pharyngotomy for the removal of a portion of a bayonet compressing the laryngeal nerve, and several cases of wounds of the abdomen complicated with injury of the intestines and bladder—all successful.

Larrey points out that Faure reported after the battle of Fontenoy that of 300 amputations only 30 recovered, but that in his cases three-fourths of the patients recovered. He attributed these results to primary operations and to a more simple, speedy, and less painful method of operation. The asepsis, which in a certain number of cases must have existed, is no doubt to be attributed to the rapidity, and therefore extreme simplicity, of the method employed. Warm camphorated or sweetened wine often formed an application on the dressing, and may have contributed to the favorable result.[2]

As severe a test as any upon his method was the successful excision of loose cartilages from the knee-joint. The operation consisted of a single cut while the skin was held tense, and was practically a subcutaneous operation, a plaster was quickly clapped on, and the wound healed by first intention. We may still be able to learn something from these old campaigners!

Ollier says rapidity was the quality demanded of all operators,

[1] Physic and Physicians.

[2] Larrey relates that after the battle of Moskowa he performed amputation at the shoulder-joint on a Chef de Bataillon, who immediately after the wound was dressed mounted his horse and departed for France. The horse died en route, but the officer arrived home safely.

with coolness and accurate anatomical knowledge. To operate well was a most difficult task. These operations were spectacular, but the dressers became afterward but too well aware of their imperfections. This was particularly true of operations for disease as contrasted with those for traumatism. From 1836 to 1841 major amputations for disease gave a mortality of 50 per cent., while those for traumatism were only 3 per cent. "The old operators endeavored to operate quickly; those of today endeavor to operate well."

The methods of civil practice were of the same rough-and-ready nature, and considerable skill was shown even by the country practitioner.

Blenkinsop[1] describes his first experience of this kind—his cross-country riding, with his principal, to an amputation:

"In this kind of practice," said my companion, "it is necessary to have our instruments well secured; you see I have mine strapped fast around my body; I lost them once when I was going to amputate an arm; but I sharpened a cheese knife and borrowed the carpenter's saw, and got through it pretty well."

Then follows the graphic description of their arrival at a small farm-house, of the doctor's interview with the man's wife, and of the nature of the injury, which involved an amputation high up in the thigh. The good wife having been disposed of by being sent on a fool's errand, the case was explained to the patient. "Meanwhile every preparation had been made, and the man's consent had scarcely passed his lips when the tourniquet was applied and the first cut made. 'Attend to me,' said the Doctor, 'watch everything I do, and I'll explain it afterward.' I felt a sad sickening and swimming of the head, but kept it down as well as I could, never for a moment taking my eyes off the quivering flesh; I nearly gave way when the bone was being sawed, but happily did not faint, and was as alert and attentive as possible. The operation, I think, scarcely exceeded ten minutes, and when the wife returned the patient expressed himself comfortable and nearly free from pain."

It is hardly necessary for me to enumerate before such a body as this the rapid improvements which took place in surgery

[1] Memoirs of Dr. Blenkinsop, written by himself. London, 1852.

under the lead of the masters of the French and English schools in the early part of this century. The scope of operative surgery was thereby greatly increased, but some improved and elaborate methods brought with them prolongation of the operation and great increase of pain. People were afraid to undergo them. It was only the few who were made of sterner metal that had the hardihood to subject themselves to the ordeal. Such were the veterans of the Napoleonic campaigns, and Ollier relates how in his early days he had occasion to operate upon some of these men who refused etherization, which they regarded as the refuge of cowards, and laid motionless under the bistoury.

Of such material also was Dr. Ebenezer Hunt, who in 1789 consulted the councillors of the Massachusetts Medical Society in regard to a cancer near the ear. They decided that it must be eradicated. It was agreed that on the next day the operation should be performed. Accordingly in a full meeting Dr. John Warren was selected as the operator. "We must bind his hands," said Dr. Warren. "No cable in Boston could hold them fast," rejoined Dr. Hunt, and with an effort that astonished the physicians themselves he quietly laid his head upon the pillow and bade them begin. The ear was nearly cut off, though afterward successfully replaced, then for thirteen minutes the operation continued and every stroke of the knife so near the auditory nerve was like the report of a pistol. Dr. Hunt did not flinch in the least, though the sweat poured down his cheeks profusely. At length all was done, and as he raised his stately form his first words were "Now give me a certificate." Dr. Warren did not understand him, and asked for what reason. "Why," continued Dr. Hunt, "that I was not cropped for making money."

Cases have been reported of death from fright before the operation. Dupuytren said "La douleur tue comme l'hemorrhagie."

John C. Warren writing a year after the introduction of anæsthesia says: "In order to form a proper estimate of the value of the new practice, we should endeavor to realize the mental condition which precedes a surgical operation. As soon as a patient is condemned to the knife what terrors does his

imagination inflict? How many sleepless nights and horrible dreams and sinking of the heart does he experience? What apprehension of dangerous bleedings of wounds of vital parts and even sudden death does he paint to himself? And when to these is added the dread of insupportable pain, what a frightful picture presents itself to his mind? No wonder many persons are unable to bring themselves to submit. No wonder that some, worn out to desperation, are led to anticipate their sufferings by a voluntary death. Horror of the knife led a gentleman in this city afflicted with stone in the bladder to commit suicide." And well might he dread "the exquisite suffering, the spasmodic contraction of the wounded muscle, the irregular pouch-like contractions of the muscular coat of the bladder" which acted as obstacles to the operation of lithotomy before the days of ether. The same author stated in a paper in 1844 that in the course of forty years he had been called on to perform all the operations for stone which had been done in Boston. The whole number had not exceeded twenty-five cases.

It is not to be wondered that surgery languished, and that the old feeling against surgery which was so strong in the last century should leave traces of it among the representatives of surgery of the first half of the present century. Robert Liston, only two years before ether was first used, held practically the same opinion as to the operative part of surgery. In a lecture on operative surgery given in the University College Hospital in 1844, he says: "This is regarded as an inferior part of our professional duties, and truly it is so. The field of operative surgery, though happily narrowed, is still extensive."

What a contrast? A great surgeon two years before the dawn of anæsthesia rejoicing that the field of operative surgery was narrowed.

Students of surgery were taught how to give the least pain. Liston's directions were as follows:

"The divisions of the skin must inflict pain; but there is a way to render it less severe than it would otherwise be. The mode of cutting must be acquired to attain this desirable end. In the first place, you

must not divide the skin by scratches. You must carry the knife completely through the tissues at once, and doing it with rapidity you will save the patient a great deal of pain. Then, again, by cutting the skin from within outward, instead of from without inward, you diminish suffering. This mode may be adopted in many operations. In hernias, the removal of tumors, and in many amputations, the parts may be divided in this way with one-twentieth part of the suffering, often enough most unnecessarily inflicted."

Many surgeons abandoned the use of the knife and employed caustics in the eradication of tumors and other forms of chronic disease.

Amputation by transfixion was generally adopted as being not only more rapid but much less painful.

Anæsthesia.

The records of ancient history show that physicians and surgeons had in mind the possibility of an agent being discovered, the use of which might prevent pain in surgical operations. The various potions that were from time to time recommended for this purpose have little more than an antiquarian interest.

Although it has been said that the discovery of surgical anæsthesia was a surprise, that its advent was marked by no tentative steps, that it appeared to have had no preliminary experimental stage, but burst like a revelation upon the medical profession as well as the community, virtually in the fulness of perfection;[1] yet a retrospective glance at the history of the previous half century will show that the idea was working in men's minds more powerfully than before, and that, as Paget says, a great truth lay unobserved, though it was covered by only so thin a veil that a careful physiological research must have discovered it. Dotted here and there over this stretch of time we find suggestions and hints full of significance today, but which at that period found no congenial soil in which to

[1] Hodges: The Introduction of Surgical Anæsthesia.

germinate into a substantial addition to the knowledge of the world One of the earliest of these was that of Davy.

Sir Humphrey Davy, a pupil of Mr. Borlase, a surgeon at Bodwin, had acquitted himself so well in the study of chemistry that he was invited by Dr. Bedoes, of Bristol, to become the Superintendent of a Pneumatic Institution established at Clifton for the purpose of trying the medicinal effects of different gases. After two years' work he published, at the age of twenty-two, an essay on chemical and philosophical researches concerning nitrous oxide. He observed the peculiar phenomena which gave it the name of "laughing gas;" and he saw people made temporarily insensible by it. Among other suggestions, being of a surgical turn of mind, he wrote in his papers: "As nitrous oxide in its extensive operation appears capable of destroying physical pain, it may probably be used with advantage during surgical operations in which no great effusion of blood takes place."

The striking peculiarity of this gas gave teachers on chemistry an opportunity to popularize their lectures by closing them with an exhibition of the laughing qualities of the gas, and it continued to be administered to individuals in small doses with this sole object in view; and the important fact hinted at by Davy was overlooked, as it was only when administered in a much larger volume that insensibility took place.

It was during one of these popular exhibitions, given in Hartford, in December, 1844, by Colton, that an individual while under the influence of the gas sustained several bruises which did not appear to cause him pain. This led one of the audience, Horace Wells, to remark, "A person might have a tooth extracted while under the influence of this gas and not experience pain." At Wells's request Colton went to his office and administered the gas to Wells while Riggs extracted a diseased tooth. The operation was a success, and Wells exclaimed after the effects of the gas had subsided, "A new era in tooth-pulling.

The popularization of laughing gas suggested the employment of other agents which might produce similar results. Thus

it was that ether came to be used on similar occasions as well as for "ether frolics" by medical students and others.[1] An article written in 1818, probably by Faraday, states that, "When the vapor of ether mixed with common air is inhaled, it produces effects similar to those occasioned by nitrous oxide." It calls attention to the necessity of using caution in experiments of this kind, and cites the case of a gentleman who was thrown into a state of prolonged insensibility by its use in this way.

Ether had already been known at this time for nearly a century, the earliest period at which this fluid was distinctly mentioned by the name of ether being in the *Transactions of the Royal Society* for 1730, by Godfrey. From this time on the attention of chemists was much directed to ether. It was also often used in the last century for the relief of spasmodic asthma, phthisis, and some other diseases of the chest. John C. Warren used it in Boston in 1805 to relieve the distress attending the last stage of pulmonary consumption, and very frequently after that, and notably in the year 1812 in the case of a member of his own family. Dr. Warren states that the manner in which it was applied was by moistening a handkerchief and placing it near the face of the patient. The quotations by Pareira of the dangerous effects produced in the above-mentioned experiment, related by Faraday, served evidently to ward off suspicion of its more useful qualities, and it still continued to be occasionally used for its medicinal virtues and for similar purposes as that to which nitrous oxide was devoted.

[1] CAMBRIDGE, February 15, 1877.

MY DEAR DR. WARREN: Your note with regard to experiments with ether at the Massachusetts General Hospital in 1836 has reached me.

I remember well our amusement with sulphuric ether; Dr. Samuel Parkman was the House-surgeon, I was House-physician, and Mr. C. K. Whipple House-apothecary.

We were especially jubilant when Mr. Whipple ordered a fresh quantity of ether, for it was apt to deteriorate by keeping. Each tested it by breathing it from the bottle till it produced unconsciousness, the others watching the different effects upon each.

We also experimented upon rats in a glass-globe until they were entirely motionless and often wondered that the treatment did them no harm. But with all our experiments we never thought of trying the sensibility under ether, even by pricking with a pin. It was a great oversight.

As ever, sincerely yours,

MORRILL WYMAN.

It was on one of these occasions that a young man by the name of Wilhite, who was attending an entertainment given in Athens, Georgia, in 1839, compelled a negro boy to take ether. The boy resisted, but the ether was forced more energetically upon him, and complete insensibility took place. In this same year Dr. Crawford W. Long graduated from the Medical Department of the University of Pennsylvania and began practice in Georgia; and, it being a common occurrence to use ether in this way at social gatherings, it occurred to him to try the same agent in surgical operations. In 1842 he accordingly removed a small encysted tumor about one-half inch in diameter, and subsequently performed one or two other minor operations. He was not, however, fully satisfied that the anæsthesia was produced by the ether and that it was not the effect of the imagination. His patients were not carried beyond the "state of exhilaration," and he admits that having found ether impracticable, owing to the short duration of the anæsthetic state, he therefore abandoned it. Long came very near achieving success, but the conditions surrounding him were unfavorable to such a result. He lived in a little Southern country town remote from the centres of civilization; the germ of inspiration received no encouragement, and the great opportunity was missed.

Meanwhile Wells followed up his first experience by extracting several teeth, four in all, from several individuals. Wells visited Boston in January, 1845, and applied to Dr. John C. Warren for permission to try the gas. The experiment was made before the class, but the patient screamed with pain, and the spectators laughed and hissed. Wells' failure was due to his neglect to depart from the ordinary plan of administering an exhilarating dose, only an amount of gas insufficient to insure anæsthesia. Again, it was a failure to recognize the necessity of an adequate dose which prevented the achievement of success. Wells soon abandoned dentistry on account of his health, and the following year departed for Europe as a business agent. He never perfected the method of administration of nitrous oxide gas.

Colton, who made annual lecture tours, continued to use the gas in his lectures in chemistry merely as an agent to amuse and interest his audience, and was in the habit of referring to the work Wells had done; but the public, remembering the fate of Wells, was not convinced, and no physician or dentist attempted to use it. It was not, therefore, until fifteen years after the death of Wells that Colton succeeded in bringing the gas into general use as an anæsthetic agent in dentistry.

Anæsthesia had been the dream of many surgeons and scientists, but it had been classed with aërial navigation and other improbable inventions.

Warren refers to the sinking of the heart he felt in the distress of very painful operations to which no habit could render him insensible. Such feelings led to various trials with many different agents—with opium in all its forms, and other narcotics, even in such quantities as really alarmed him, without any satisfactory results.[1]

The first scientific account of the employment of hypnotic anæsthesia for surgical purposes was given by Recamier and Baron de Potel in about 1821. It was recommended by Cloquet in 1829, who removed a cancer of the breast by its use, without pain. Esdale began to employ it as an anæsthetic in surgery in 1846.[2] In Boston it was used successfully in the extraction of a tooth in 1836, the patient remaining under its influence about seventeen minutes;[3] but Warren states that mesmerism had never succeeded in cases under his inspection.

In 1839 Velpeau wrote: "To escape pain in surgical operations is a chimera which we are not permitted to look for in our day. A cutting instrument and pain in operative medicine are two words which never present themselves, the one without the other, in the minds of the patients, and it is necessary for us surgeons to admit their association."

Scientific men were, however, now beginning to turn their

[1] Warren on Etherization, 1848.
[2] American Journal of Obstetrics, September, 1896.
[3] Boston Medical and Surgical Journal, July 6, 1836.

attention to these anæsthetic agents. For instance, M. Ducros[1] presented a memoir to the Academy of Science in Paris, in which he showed that sulphuric ether applied to the buccal and pharyngeal membranes of certain animals produced an immediate sleep, and that it produced similar effects on man. He recommends its use in this way in hypochondriasis and insomnia. Rubbed upon the tongue, the soft palate, and the tonsils ether produces an agreeable sleep. He advises its use also in puerperal eclampsia, in hysterical and epileptiform attacks, and in trismus. Virchow also states that in Berlin, in 1846, he had made independent investigations on "æther narkose."[2]

Warren said of ether in 1848: "Its general properties have been known for more than a century, and the effect of its inhalation in producing exhilaration and insensibility has been understood for many years, not only by the scientific, but by young men in colleges and schools, and in the shop of the apothecary, who has frequently employed it for these purposes." Ether was evèn used in surgery, Thacher, of Plymouth, employing it as a refrigerator for the reduction of strangulated hernia.

Such was the situation when we first begin to hear of Morton. As a dentist he had introduced a new form of plate, which necessitated the removal of the old fangs. For this purpose he had on one occasion been obliged to use as much as 500 drops of laudanum in forty-five minutes. Finding that he was not successful in persuading patients to submit to his methods of treatment, and that they were leaving him for other dentists, he was led to seek for some method of painless extraction. In July, 1844, he used sulphuric ether, locally applied, to relieve the pain of a sensitive tooth. It is said that Jackson had recommended chloric ether to several dentists as effective "toothache drops" about this time. Morton had been at one time an inmate of Jackson's house, and doubtless had an opportunity to listen to the discussion of some of the more important chemical problems of that day, and heard of the

[1] Gazette Médicale de Paris, March 16, 1846.

[2] Boston Medical and Surgical Journal, October 15, 1896.

ether frolics and what Jackson thought of them. As a former partner of Wells, he was quite familiar with his work, and after Wells' Boston failure his experiments on the local use of ether came back to his mind, and the thought occurred to him to use ether as Wells had nitrous oxide. Doubtless, also, the well-known effect of ether as an exhilarant was as familiar to him as it was to other young students of that day. During the following spring and summer he experimented with ether upon several kinds of animals, and also upon students in his office. The result so far as the students were concerned were, however, not successful, as the article then supplied by druggists was not of good quality. Having acquainted himself by conversation with Mr. Metcalf and Mr. Burnett, both leading druggists, as to the purity and qualities of ether, and having also conversed with Mr. Wightman, a philosophical instrument-maker, and with Dr. Jackson as to an inhaling apparatus, Morton proceeded to experiment upon himself. After inhaling the purer quality of ether from a handkerchief he awoke to find that he had been insensible for seven or eight minutes.

The same day a stout, healthy man came to his office suffering from great pain and desiring to have a tooth extracted. Dreading the pain, he accepted willingly Morton's proposal to use ether, and the tooth was extracted without suffering. Morton reported his success the next day to Jackson, and conversed with him as to the best methods of bringing his discovery to the attention of the medical profession and the public. Jackson pointed out that tooth-pulling was not a sufficient test, as many people claimed to have teeth pulled without pain. It was finally decided that the crucial test lay in a public demonstration in the operating-theatre of a hospital in a surgical case.

Dr. J. Mason Warren, one of the actors in the scene, thus describes what next took place:

"In the autumn of 1846 Dr. W. T. G. Morton, a dentist in Boston, a person of great ingenuity, patience, and pertinacity of purpose, called on me several times to show some of his inventions. At that time I introduced him to Dr. John C. Warren. Shortly after, in October, I learned from Dr. Warren

that Dr. Morton had visited him and informed him that he was in possession of or had discovered a means of preventing pain, which he had proved in dental operations, and wished Dr. Warren to give him an opportunity in a surgical operation. After some questions on the subject in regard to its action and the safety of it, Dr. Warren promised that he would do so. . . . The operation was therefore deferred until Friday, October 16th, when the ether was administered by Dr. Morton and the operation performed by Dr. Warren."[1] The operation is thus described by Dr. John C. Warren:[2]

"The patient was a young man, about twenty years old, having a tumor on the left side of the neck, lying parallel to and just below the left portion of the lower jaw. This tumor, which had probably existed from his birth, seemed to be composed of tortuous, indurated veins extending from the surface quite deeply under the tongue. My plan was to expose these veins by dissection sufficiently to enable me to pass a ligature around them. The patient was arranged for the operation in a sitting posture, and everything made ready; but Dr. Morton did not appear until the lapse of nearly half an hour. I was about to proceed, when he entered hastily, excused the delay, which had been occasioned by his modifying the apparatus for the administration. The patient was then made to inhale a fluid from a tube connected with a glass globe. After four or five minutes he appeared to be asleep, and was thought by Dr. Morton to be in a condition for the operation. I made an incision between two and three inches long in the direction of the tumor, and to my great surprise without any starting, crying, or other indication of pain. The fascia was then divided, the patient still appearing wholly insensible. Then followed the insulation of the veins, during which he began to move his limbs, cry out, and utter extraordinary expressions. These phenomena led to a doubt of the success of the application; and in truth I was not satisfied myself, until I had, soon after the operation and on

[1] J. Mason Warren: Surgical Observations, with Cases, 1867.

[2] John C. Warren: Etherization, 1847.

various other occasions, asked the question whether he had suffered pain. To this he always replied in the negative, adding, however, that he knew of the operation, and comparing the stroke of the knife to that of a blunt instrument passed roughly across his neck." To resume Mason Warren's account: "On the following day a woman requiring the removal of an adipose tumor from the arm was rendered insensible by ether given by Dr. Morton; and Dr. Warren requested Dr. Hayward, one of the visiting surgeons who was present, to perform the operation. This was successful; the ether being continued through the whole operation, which was a short one, and the patient being entirely insensible."

Dr. John C. Warren writes: "Anxious to extend the benefits of the inhalation to as many patients as possible, believing a peculiar apparatus necessary, and having the use of none excepting that in the hands of Dr. Morton, I requested Dr. Charles Heywood, the house surgeon of the hospital (who took an early and active interest in this matter) to procure a glass globe and add to it the tube necessary for its application. At this period, however, I was checked by the information that an exclusive patent had been taken out, and that no application could be made without the permission of the proprietor. The knowledge of this patent decided me not to use nor encourage the use of the inhalation until a more liberal arrangement could be made. Dr. Hayward concurred with us, and having procured from Dr. Morton a letter of explanation to the surgeons of the hospital which was judged satisfactory, we felt ourselves justified in prosecuting the practice without restriction."

Resuming Mason Warren's account, we find that after the second operation:

"The success of this process in the prevention of pain was now quite established. Its use, however, was suspended for a time, for reasons which Dr. Warren has already given in his first paper on ether. And the experiments were not again resumed until November 7th, when Dr. Morton declared his willingness to state the nature of the agent employed. Two important operations were now done successfully at the Massa-

chusetts General Hospital under its agency: one, an amputation of the thigh by Dr. Hayward; the other a very difficult and bloody operation—removal of a portion of the upper jaw in a woman—by Dr. Warren."[1]

On December 21st Liston, in London, amputated a thigh and performed an evulsion of the toe-nail with perfectly satisfactory results. It is related that Liston's surprise and delight at the success of his first use of ether were remembered for years after by his assistants and the spectators.

Dr. F. W. Fisher, of Boston, then a medical student in Paris, first gave ether for Jobert de Lambelle on December 15th, but with only partial success. On January 12th Malgaigne reported to the Academy of Medicine the results of four operations performed under ether at the St. Louis Hospital; and on January 23d Fisher administered ether with a "Boston Inhaler," at the invitation of Roux, with perfect success.

As is frequently the case in this country, the new home product was not received with the enthusiasm it would have been had the same emanated from one of the great European clinics. In one great hospital it is recorded a year after this discovery that ether had not been used, "being considered by the judicious surgeons of that institution of doubtful safety, or, at least, as not sufficiently established as to warrant them in its employment." Many major operations were performed in Philadelphia without anæsthesia as late as 1850 or even later.

[1] Dr. John C. Warren was the senior surgeon of the hospital at this period and the leading surgeon in New England, if not in the country. Holmes said of him: "He had reached the age when men have long ceased to be called for military duty; when those who have labored during their days of strength are expected to repose, and when the mind is thought to have lost its aptitude for innovating knowledge, and to live on its accumulated stores. Yet nothing could surpass the eagerness with which he watched and assisted in the development of the new discovered powers of etherization. It is much for any name to be associated with the triumphs of that beneficent discovery; but when we remember the reproach cast upon Harvey's contemporaries, that none of them past middle age would accept his new doctrine of the circulation, we confess it to have been a noble sight when an old man was found among the foremost to proclaim the great fact . . . strangely unwelcome as well as improbable to some who should have been foremost to accept it—that pain was no longer the master but the servant of the body."

It was not at first thought necessary to give more than a single dose of ether. Continuous etherization was only gradually reached. Many prolonged operations could not therefore at first be carried on by this method. In order to convince those who were still doubting, the members of the Massachusetts Medical Society at their annual meeting in May, 1847, were invited to visit the Massachusetts General Hospital and witness operations under ether.

"After two operations with etherization, which succeeded perfectly, a delicate female, laboring under a disease of the spinal marrow, with general neuralgia, was subjected to the actual cautery. A space on each side of the dorso-lumbar region of the spine was cauterized by red-hot irons, one of which was an inch square, passed up and down slowly three times on each side without the slightest suffering."

An eye-witness to this event informed the writer many years ago that when the assembled physicians saw and smelled the cloud of smoke ascending to the roof of the operating-theatre while the patient was slumbering peacefully, all doubts as to the efficacy of the new method vanished forever.

Thus the great step was taken, the "thin" veil was suddenly thrown aside, and what had been before a surmise of the scientist, a pastime of the idle student, and the dream of the surgeon, suddenly assumed practical form and shape, and became a living truth revealed in all the fulness of perfection.

In looking back over the period just outlined, a half century later, it seems as if the observer could see with a clearer vision and reason with calmer judgment. The minor controversies of those days have already faded into the past, while the salient truths stand out all the more clearly.

In due course of time science gave first one and then another anæsthetic to the world, but the world toyed with them for half a century, nearing and receding from the truth in a tantalizing way until a practical man came forward, pushed aside one or two apparently unimportant obstacles, and, guided by good advisers, was fortunate enough to put the new method to that crucial test for which it had so long waited. As Ashhurst has

well said: "Surgeons went on in every country cutting and burning, and patients went on writhing and screaming until, on October 16, 1846, when surgical anæsthesia became the priceless heritage of the civilized world."

Surgery after Anæsthesia.

Warren, writing in 1848, says: "A new era has opened to the operating surgeon. With what fresh vigor does the living surgeon, who is ready to resign the scalpel, grasp it and wish again to go through his career under the new auspices? Since the fear of pain has diminished, the number of surgical operations has remarkably increased, at least in our vicinity."

An editorial article in the *Lancet*, written about six months after ether was first used in Boston, states that the number of operations in the London hospitals had more than doubled.

Mason Warren writes: "The domain of surgery has been enlarged by admitting into the list of justifiable operations some whose severity would otherwise in most cases have prevented even the thought of attempting them."

Erichsen writes in 1878: "During the last thirty years the actual number of operations performed in hospitals has enormously increased, and probably in a great measure owing to the employment of anæsthetics."

Marshall, the Emeritus Professor of Surgery at the University College Hospital, in 1885 compared the surgical work of the hospital in Liston's time, in 1844, and his own.[1]

Although the proportion of fractures and wounds was about the same in the two periods under comparison, the number of surgical cases admitted to the hospital in 1885 was more than double the number admitted in 1844. A numerical comparison, however, gives an inadequate idea of the increased amount of surgical cases, for in 1844 simple cases were treated as out-patients, and venereal cases in large numbers were admitted to the wards. In 1883 more patients with malignant growths came

[1] British Medical Journal, August 8, 1885.

for operation. This was attributed not to the increase of malignant diseases, but to the willingness of persons to be operated upon under anæsthesia.

Diseases of the bones and joints did not differ much comparatively. Stricture of the urethra was operated upon very much more often in 1883.

In the whole year of 1844 there came into the surgical ward of the University College Hospital only one case each of ovarian tumor, of aneurism, and of vesico-vaginal fistula. Jones records[1] that from 1830 to 1850 he found no recorded case of excision of the knee, but in 1850 to 1854 there were twenty-one cases. With the increase in surgical work came a great increase in the relative cost of hospital maintenance. In the University College Hospital the expenses for surgical supplies in 1844 were £206, and in 1883 £1765, of which £1273 went for modern surgical dressings. The cost of instruments in 1883 was more than doubled.

The following table, taken from the record books of the Massachusetts General Hospital, enables one to compare the work done after the advent of anæsthesia with the period immediately preceding it:

	For five years before anæsthesia.		For five years after anæsthesia.	
	Number.	Mortality.	Number.	Mortality.
Total operations	184	6¼ p.c.	487	9 p.c.
Tumors (excluding breasts)	39	5 "	122	3 "
Amputation of breast	13	8 "	30	10 "
Plastic operations	6	0 "	33	3 "
Amputations: Hand, Foot, Arm, Leg	13	15 "	65	23 "
Hernia: Strangulated gut freed by incision	5	60 "	1	0 "
Reduced by taxis under ether	0	.....	2	0 "
Radical cure, plastic	0	.....	0	0 "
injection iodine	0	.....	11	0 "
Laparotomy	0	.....	4	75 "

[1] Medico-Chirurgical Transactions, 1854.

It will be noticed that there was a marked increase in the number of "voluntary" operations—*i. e.*, operations which were not matters of absolute necessity to preserve life—such as tumors or *operations de lux*, such as plastic surgery. The total number of operations during the five years following the introduction of ether was over two and one-half times as great as that in the five preceding years.

The question whether anæsthetics increased mortality or not was one which was much discussed formerly. Simpson believes that they did not. Arnott brought forward figures to show that the mortality had been increased 12 per cent. in amputations, and 28 per cent. in lithotomy. Erichsen also believed the mortality rate had increased since the use of anæsthetics in operative surgery. Curling gives the mortality of amputations of thigh and leg in the London hospitals for 1837–1843 at 41 per cent. During 1847 in 73 cases in which an anæsthetic was given the mortality was 19 per cent. At the Pennsylvania Hospital the mortality of amputation from 1835 to 1840 was 36 per cent.; from 1840 to 1845 it was 20 per cent. From 1850 to 1855 it was 23 per cent., and from 1855 to 1860 it was 31 per cent. At the Massachusetts General Hospital the death-rate was, as a rule, increased in the different classes of operations. The rapidity with which certain operations were performed undoubtedly favored asepsis, particularly in all aseptic cases, and probably in any operation which could be done quickly and thoroughly.

In many cases of spreading sepsis rapidity was a bar to thoroughness, and results were corresponding unsatisfactory.

A young man presented himself at the Hôtel Dieu in 1845, with palmar abscess, but as no opening was made, the arm became involved the following day, pus having found its way under the annular ligament. The bistoury was produced, plunged deeply between the pronators and supinators of the forearm, and carried up rapidly from the wrist to the bend of the elbow; the arm fell open and a pint of matter instantly escaped, but with it jets of florid blood from the brachial end of the wound. The brachial artery had to be tied, and when the reporter left Paris the surgeons were contemplating amputation at the shoulder-joint.—*Lancet*, January 11, 1845.

The contrast of anæsthesia in such cases is a strong one. The days of anxiety which visited patients and their medical advisers previous to an operation were, with the discovery of anæsthesia, immediately swept away, and the problem of the relief of disease by surgery became vastly simplified. Surgeons could now operate promptly but with deliberation and thoroughness.

The enormous increase in the number of surgical cases brought about conditions for which hospitals and surgeons were alike unprepared.

When we reflect how few of the aids to surgical diagnosis were possessed by surgeons in 1846, the amount of work which they accomplished presents all the stronger contrast. They had no endoscope, no ophthalmoscope, no modern aspirating-needle, no clinical thermometer, and no laryngoscope. The stethoscopes were far from perfect. Examination of the blood and the quantitative analysis of the excretions were unknown. The microscope was just coming into use for pathological purposes. They possessed, however, an excellent technique so far as operative surgery was concerned. Their capacity for operating was unlimited, but their judgment was not guided by the many aids which serve us today.

There was an activity in the operating-theatre in times of peace that had never before been known. But with this great increase in hospital activity came a corresponding increase in hospital pests, and it seems highly probable that during the twenty years following the introduction of anæsthesia the opportunity to study septic diseases was greater than it ever had been. Mason Warren, writing in 1864, says: "I remember the time when, after an amputation or the excision of a breast or a large tumor, it was the universal rule to bring the edges of the cut integuments together nicely with straps, compress, and a bandage, with the full assurance of finding the wound nearly healed at the removal of the dressing. At the present day, however, such a result is seldom attained in city practice; union by first intention being for the past twenty years the rare exception, suppuration almost always ensuing in the deeper parts."

In about 1860 septic processes ran rife at the Massachusetts

General Hospital, and the writer well remembers a virulent epidemic of hospital gangrene which got quite beyond the control of the surgeons. In the winter of 1867 and 1868, in Vienna, Billroth's wounds were full of pyæmia, erysipelas, and hospital gangrene, as the autopsy table but too frequently showed. Students and many practitioners of today have but a faint conception of the appearances of wounds and ravages of sepsis with which the surgeon of that time had to contend. As a house officer at the Massachusetts General Hospital, I can well remember the tone of despair with which my father remarked, on learning from me of a fatal result following one of his operations: "I am often nearly disgusted with surgery."

It would be beyond the scope of this article to undertake to show how the speculation of Liebig[1] and others became tremendous truths in the hands of Pasteur and Lister, and the beneficent influence which the next great discovery of the century exerted upon human suffering.

It is interesting to note, however, the strangely appropriate order in which the great facts of medicine and surgery were given to the world in this progressive century. Hunter had already roused the thirst for knowledge which led others to rush forward and immortalize themselves as pioneers in anatomy, like Bichat, or modern surgery, like Cooper. Then came the work of the pathologists, such as Cruveilhier and the host of German pioneers. Just as the surgeon had brought his operative technique to a high degree of perfection, and science had made a practical instrument of the microscope, and preparation had been made for another advance all along the line, then came anæsthesia, which widened the field of research sufficiently to occupy the world busily for another quarter of a century. It gave to surgery a more powerful impetus than it did to experimental medicine. At a moment when surgery seemed rushing

[1] Liebig in a lecture delivered in the spring of 1844 said, in speaking of fermentation and putrefaction, "I cannot conclude without mentioning a notion which some persons, and especially physicians, have formed respecting causes. The putrefaction of animal substances they ascribe to the development of microscopic animalculæ —vegetable beings —fungi. The correctness of the theory was denied by Liebig at this time.

wildly onward to its own destruction, with science lagging far behind, Lister came to the rescue, and scientific equilibrium was again restored.

Gentlemen: The old Massachusetts General Hospital stands as it did in 1846, with its sightly Bulfinch dome and granite columns. From a scientific standpoint it seems an antiquated structure in comparison with the modern pavilion wards, laboratories, and operating-theatres which surround it, but it will never be torn down. It will always remain one of the conspicuous landmarks of this wonderful century—as a shrine of surgery sacred to that moment "when the fiercest extremity of suffering was steeped in the waters of forgetfulness, and the deepest furrow in the knotted brow of agony was smoothed away forever."

[NOTE.—The illustration represents the operating-theatre of the Massachusetts General Hospital in the winter of 1847. The sponge used here is known as the first sponge with which ether was given. This method was adopted in February, 1847, by Dr. J. Mason Warren. The surgeons whose portraits appear in this picture are, on the patient's left, Dr. John C. Warren, Dr. Samuel Parkman; on the patient's right, Dr. J. Mason Warren and Dr. Townsend. The etherizer is probably Dr. Heywood. The daguerrotype from which the photogravure is taken has been in the possession of the writer's family since that time.]

THE INDICATIONS FOR AND THE TECHNIQUE OF HYSTERECTOMY.

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THE INDICATIONS FOR HYSTERECTOMY. When should the uterus be removed?

1. In tractable, oft recurring hemorrhage without discovered fibroid or malignant disease, when all the usual remedies have been tried and curetting has been done every few weeks without permanent success. Clinical reasons prevail over histological, and practical over theoretical.

2. In all kinds of malignant disease, when the operation is possible without permanent injury to the bladder or bowels. Even if there is little hope of cure, the hemorrhage may be stopped, and there is less subsequent pain and discomfort than when the disease is left to run its natural course.

3. (*a*) In a case of fibroid tumor which causes much discomfort or (*b*) threatens death by hemorrhage (and it does sometimes not only threaten, but causes it as suddenly as a pulmonary hemorrhage does). (*c*) Because it may increase and become too burdensome to allow life to be worth living. (*d*) Because it may develop a cancerous character. (*e*) Because by its pressure on the abdominal organs it may destroy life. (*f*) Because it may become cystic and thoroughly adherent. I do not mean fibroids with dilated lymph-spaces, but fibroids with cysts as clear and distinct as those in ovarian tumors. (*g*) Because it may be an ever-present anxiety. (*h*) Because it may cause œdema of one or both extremities and phlebitis, to be followed, perhaps, by the passage of an embolus into the circulation,

causing death by cardiac, renal, pulmonary, or hepatic disease. (*i*) Because it may become twisted with the uterus as a pedicle and must be removed immediately to save life; I have seen this once. (*j*) Because a very sensitive single woman, in good health and active, demands its removal on account of the disfigurement it causes. (*k*) Because the operation, today, in experienced hands, is almost uniformly successful.

4. In cases of uncontrollable, complete prolapse, particularly after the menopause, when pessaries and all the usual operations for holding up the uterus have been tried and found useless.

5. In cases of incurable chronic inversion.

6. In cases of infection when the removal of the Fallopian tubes affected with salpingitis has not cured the patient.

The French surgeons of the present day have a great deal of right on their side when they claim that the uterus is the infecting organ, and that in many cases there will be no cure until it is removed.

It has seemed to me that the removal of *non-adherent* tubes, no matter how large or how chronic, has cured the patient. In few of the cases where I have (as the expression is) "dug out" *adherent* tubes and ovaries have the patients been cured of their back aches and nervous symptoms, though most of them have gained in weight and appearance.

7. To cure puerperal sepsis where the diagnosis is as certain as it can be.[1]

The two following cases are examples of the first class enumerated as proper ones for hysterectomy. The first was one of chronic hyperplastic endometritis. The other was one where an undiscovered fibroid existed in the right cornu, and gave rise, from time to time, to severe hemorrhage.

Case I.—I saw, in the latter part of January, 1894, with Dr. Morrill Wyman, and Prof. W. L. Richardson, a married woman, aged thirty-eight years, the mother of five children. Severe flowing, becoming constant, had begun in November, 1893, and had continued until

[1] See report of case by Dr. C. B. Penrose, in The American Journal of Obstetrics, May, 1894.

I curetted on January 30, 1894. I removed several ounces of hyperplastic material, which I gave to Dr. W. F. Whitney, Pathologist of the Massachusetts General Hospital and Curator of the Warren Museum. His report is as follows: "Microscopical examination showed the structure to be made up of large tubular glands, in places more or less dilated, and with fatty-degenerated epithelial cells. The interglandular substance was of a small, round, and spindle-celled type, and well vascularized. There were no muscular fibres found. The diagnosis is hyperplastic endometritis, with some fatty degeneration of the glands. I could find no evidence of true cancer or malignant adenoma." After ten days the flowing ceased, and then began a fortnight later and continued, so that in April it was necessary to curette again. This manœuvre once more stopped the flowing for a time; but by the middle of May it recurred freely. From the time of the first curetting the patient had been taking iron and tonics, and had gained considerably in strength and color. During the summer there was more or less hemorrhage, and on September 2d curetted again, and as usual painted the interior of the uterus with pure carbolic acid and tincture of iodine. Flowing began in October, and on November 2d received a letter from which I will make an extract:

"I asked my husband to see you yesterday because this miserable leakage has continued daily, and is now increasing so that I feel it more, and it is almost as much as I can do to keep up my spirits and courage to fight it out. When I was told that all you could advise further was to curette and cauterize again, and try electricity, and then perhaps curette again, I was highly discouraged, for the curetting which saved me last winter seems now to have but little effect. I have faithfully tried to get well and have failed."

The result of the last curetting was sent to Dr. Mallory, who had taken Dr. Whitney's place, and his report is in part as follows:

"Uterine glands flattened, twisted, or bent, or dilated into small cysts containing desquamated cells, a few leucocytes, and about the normal amount of glandular tissue. Mitosis is fairly abundant. No formation of atypical glands or invasion of muscular tissue. Chronic proliferating endometritis."

The patient was much discouraged, and I could not suggest any measure that would certainly cure her except hysterectomy. She decided calmly and at once to have the operation done, and on November 10, 1894, I did vaginal hysterectomy by the method to be

described, securing the vessels with clamps and ligatures, the ligatures being necessary because the ovaries fell down into the vagina, and I thought it was best to remove them; in fact, one of them was cystic. Dr. Whitney examined the uterus and reported as follows:

"The uterus measured 12 cm. in length, with a cavity 10 cm. in depth, the walls of the fundus being 2 cm. thick. The uterus was also dilated, the mucous membrane was thickened and shreddy and infiltrated with blood. Microscopical examination showed large masses of tubular glands, with but relatively little interglandular substance. The basis was quite sharply defined, but here and there was extension distinctly into the muscular substance. The diagnosis is of a glandular form of hyperplastic endometritis." Recovery was rapid. There has been no more hemorrhage nor despondency. The patient has gained twenty pounds in weight and is the picture of health, and has never regretted that she decided to have the uterus removed.

Case II.—This case is interesting on account of its international character, and because of the difficulty of diagnosis. A lady, aged sixty-three years, the mother of three children, of whom the youngest was thirty six years, had uterine hemorrhage in Paris in April, 1892, and again in London in May. The London surgeon in attendance summoned a distinguished physician, and they pronounced the case one of cancer and likely to run a very rapid course. The diagnosis made by these gentlemen was based on the following conditions (as stated in a letter to the husband of the patient): "Has had hemorrhage. The uterus was enlarged. The passage of the sound caused profuse bleeding. These symptoms, together with her age and history, pointed to malignant disease. The inadvisability of an operation was based upon opinion arrived at after our examination, when the disease had already reached the stage at which any attempt to extirpate the enlarged womb would not only entail a very great risk of life, but would, moreover, fail to entirely eradicate the disease." In ninety cases out of one hundred these facts would have been sufficient to base the diagnosis of cancer upon, but as the sequel will show they were in this case fallacious. The lady sailed immediately for home. Both she and her husband were in a very depressed state. I saw her at Newport on August 5th, with Drs. Lusk and Cleveland. We etherized her, and found the uterus normal in size and surroundings and the patient healthy and well-nourished, with a normal complexion. We found no signs of cancer, and expressed that opinion decidedly in writing. We curetted the uterus, but got nothing, and found

no cause for the hemorrhage. There was no more bleeding until the last of September, and then slight; it occurred again during the latter part of October. In November I curetted, but got nothing except normal mucous membrane. On November 17, 1893, sudden and severe bleeding took place, and again on February 22d and 27th. I suggested etherization and curetting, and, if malignant adenoma was found, immediate hysterectomy. This was thought to be too radical, and I curetted again. Dr. Whitney reported hyperplasia of the endometrium. There was no evidence of cancer or malignant growth, but the uterus had become enlarged; its cavity was four inches deep. So the case went on with slight hemorrhages, slight rises of temperature, discomfort and discouragement. I could find no evidence of cancer, yet I could not account for the bleeding. On May 11, 1893, Drs. Lusk and Cleveland and I again met in consultation in Boston. The patient was etherized and the uterine canal was dilated so as to admit the finger; a distinct solid growth was felt in the right posterior uterine wall. At the patient's age it seemed likely to be malignant, but it did not feel like cancer, and there had been no offensive, clear, or bloody discharge and there was no infiltration and no adhesions in the neighborhood of the uterus. We concluded that the growth might be a sarcoma, instead of deciding correctly, as common sense would have told us, that it was the most common uterine growth and the most common cause of uterine hemorrhage—viz., a fibroid tumor protruding into the cavity of the womb. But, whatever the growth was, it was clear that there was only one thing to be done, and that quickly—namely, the removal of the uterus, and the conditions were eminently favorable for extirpation. I removed the uterus by the vaginal method to be described, using clamps on the uterine arteries, and ligatures on the ovarian.

Dr. Whitney's report is as follows: "The uterus measured about four inches, the wall three-quarters of an inch. The interior was covered by a thin, smooth membrane, marked by a few hemorrhagic spots; the cavity was dilated and partly filled by an oval tumor measuring two and one-third inches in its longest diameter and covered, except at its base, by the reflected mucous membrane. The base of the tumor was more or less intimately adherent to the muscular tissue of the fundus, where it had evidently originated, and from which point it had pushed its way into the uterine cavity, causing gradual dilatation, and carrying the mucous membrane before it. The growth was of moderate consistency; on section it was found to be relatively

loosely attached to the surrounding tissue. The section-surface was in general uniformly grayish-white in color, with here and there little slit-like openings; microscopic examinations showed its structure to be a richly cellular fibro-myoma, with large and abundant lymph-spaces. In the substance of the wall at the fundus was a second in every way similar growth of the size of a large cherry. The diagnosis is intramural and submucous polypoid fibroid-myoma of the uterus." In this case the diagnosis had not been correctly made either here or in England. The case was clearly not one of cancer, and yet a fibroid polypus would not be expected in a woman of sixty-three years. The specimen shows that the surgical treatment of the case was correct, for if I had found and removed the partially extruded tumor from the cavity of the uterus, the other one in the fundus would have descended and would have caused hemorrhage later on. The patient recovered quickly, and is now—four years later—very active and in excellent health.

The mistake and difficulty in diagnosis in this case were caused by the patient's age. The British surgeons inferred cancer on account of hemorrhage at the age of sixty-three, and the Americans did not expect a woman of sixty-three years would extrude a fibroid tumor from a senile and presumably atrophying uterus. The practical treatment of the case, however (and that is the reason why I have stated it at such length), was never in doubt in my mind. Vaginal hysterectomy was the proper thing to be done, and would and did effect a cure.

The Technique of Hysterectomy. I take it that the technique of an operation means the special manipulations that are necessary to perform it. In my descriptions I shall suppose once for all that the instruments, ligatures, gauzes, etc., have been thoroughly sterilized and are completely aseptic, that the patient's bowels have been opened, that the abdominal parietes have been shaved and otherwise properly prepared, that the vagina and uterus have been disinfected, and that all the accessible parts involved have been made clean; that the patient has been enveloped in a sterilized flannel suit, which will keep her warm and diminish shock; that she has received a subcutaneous injection of one-eighth of a grain of morphine, and one one

hundred and twentieth of atropine, which tends to diminish the bronchial secretion and to bridge over, or lengthen, the time of unconsciousness after etherization, and to keep the patient sleeping instead of coming out of the state of insensibility produced by the anæsthetic; that the surgeon and assistants have made themselves as sterile as possible. Having this clearly understood, I will not consume time in describing the necessary proceedings to obtain the above results. Once for all, let us discard the old-fashioned serre-nœud and pin of Kœberle; they served us well, but are now entirely out of date and should be wholly abandoned.

I will begin by describing the simplest hysterectomy for the simplest condition requiring the operation—namely, for intractable uterine hemorrhage without discovered malignant or fibroid disease. In this case the vaginal route is to be followed. It is important that the retractors and other instruments shall be specially adapted to the work and reliable, because one must see clearly what he is doing and do nothing by feeling; that the clamps shall not spontaneously spring open and allow the broad ligaments to escape from their grasp. The retractors and other instruments of Ségond are excellent. If the assistants are accustomed to helping the operator, so much the easier. The patient should be put in the lithotomy position and the legs should be held up by any method that is thought best. A circular incision around the os completely through the mucous membrane is made, and also two incisions on either side parallel with the axis of the organ and about one-half inch in length. The position of the bladder wall is ascertained by a curved sound passed into the urethra and felt through the upper vaginal wall. While strong traction is being made on the os and neck the bladder is peeled off from the uterus along the line of cleavage which, in the normal condition of things, is easily found. When the sound can be felt through the bladder walls above the hand it is probably pretty thoroughly and safely separated from the uterus. An opening is next made with scissors, or with the ends of a pair of forceps, through the peritoneum of the anterior cul-de-sac into the abdomen, and a retractor, not too wide, lest

it draw the ureters into the wound, is passed into the opening, and, being carefully held by an assistant, keeps the bladder out of the way and prevents the intestines from descending. Next an opening is made with more freedom into the posterior cul-de-sac, and is enlarged with the fingers. A piece of gauze with the end hanging out or a gauze sponge with a string of silk attached is inserted between the uterus and rectum. Next the fundus of the uterus is anteverted and pulled down beneath the bladder, and a strong clamp is put on the left broad ligament, parallel with the long axis of the uterus. If it is thought best to remove the ovaries, it is easier to pull them down before putting on the clamps. The same procedure is gone through with on the right side, and the uterus is cut away between the clamps. It is important to leave sufficient tissue on the uterine side of the clamps to prevent the tissues from slipping out. During the course of the operation any vessels that bleed unduly can be secured in pressure forceps or tied. It is a matter of indifference whether the ovaries and tubes are removed or not. The main thing is to get rid of the bleeding mucous lining of the uterus, and as curetting has not succeeded, we remove the whole organ.

Such cases invariably recover, if one can say that any class of cases invariably recover.

The technique for malignant or fibroid diseases of the uterus by the vaginal route is the same as that just described for the removal of the non-malignant uterus. Adeno-carcinomata for this purpose may be considered non-malignant, except that all infected tissues should be freely removed from the vaginal wall, and as far as possible from the broad ligaments. The ovaries ought also to be removed. But at the present time the weight of surgical authority is in favor of opening the abdomen in order to thoroughly remove malignant disease.

Some surgeons begin the operation by passing sounds into the ureters in order to define their position, so that they may be avoided and not cut or compressed during the necessary manipulations. To the majority of surgeons this operation of passing sounds into the ureters is not easy, nor is it necessary

for them to learn it, and although this technical proceeding has great advantages, yet it is not likely ever to be universally practised. All the glands in the neighborhood of the uterus should be removed. The peritoneum should be lightly stitched together if the operation is done by the abdominal route, but no stitches need be taken if it is done by the vaginal route. The Association is referred to vol. xii. of its *Transactions* for further remarks on this subject, in a paper which I had the honor to read before them in 1895. The ovarian arteries are tied outside the ovaries in each broad ligament, and the uterine arteries on each side of the cervix. Separation of the os from the vagina previous to opening the abdomen, facilitates the removal of the uterus, and in some instances the uterine arteries are easily secured and tied through the vagina before the abdomen is opened.

The technique for the removal of the uterus on account of cancer will vary according to the type of the disease. The adeno-carcinoma which has not extended beyond the body of the uterus may be removed by the simple vaginal method, using clamps or ligatures, as the operator prefers, to secure the vessels.

Operations for hysterectomy in adenomatous cases are almost uniformly successful, and, in my experience, are never followed by recurrence. The other forms of cancer of the uterus are followed by recurrence, probably in at least 70 per cent., and possibly in more, of all cases operated upon.

Hysterectomy is necessary in cases of fibroid tumors which cannot be enucleated either from the inside or from the outside of the uterus. The technique of hysterectomy for fibroid tumors consists in removing them by the abdominal route through an incision in the abdominal parietes, or through an incision in the vaginal walls, or by a combination of the two methods, the os and neck being freed from their vaginal surroundings through the vagina before or after we open the abdomen. If before, we may with advantage tie the uterine arteries through the vagina. It is necessary to resort to morcellation, or cutting the uterus in pieces, in many cases. Sometimes the vaginal method is preferable, and sometimes the abdominal.

I have formerly been in the habit of removing large fibroids by the abdominal route, and leaving a button, consisting of a small portion of the neck and os. This gives, theoretically at least, and I should suppose practically, a better pelvic floor than when the whole organ is removed. Lately I have usually removed the whole uterus, and I think it takes no more time to separate the neck from its vaginal attachments than it does to sew up the uterine canal, as one has to do when the os is left.

The technique of abdominal hysterectomy, when we decide to leave the neck and os, is as follows:

The patient is wrapped in a sterilized flannel suit made out of a large, thick blanket, either in one piece or in two pieces, like pajamas. This was suggested to me by my first assistant, Dr. Edward A. Pease, and is one of the causes of success. It prevents, as far as possible, any lowering of the patient's temperature, and keeps her warm during the operation and afterward. I regard this as one of the important procedures in these cases. The legs and arms of the wrap are sewed up at the ends, and the abdominal portions can be tied together with tapes, and loosened and separated for the purpose of making the incision in the anterior abdominal parietes. There is no place for the external air to get in, except while the abdomen is open. The patient is placed in the Trendelenburg position. Indeed, without this position the intraperitoneal removal of fibroids in a satisfactory manner would be impossible. The incision is made of the required length and the tumor is delivered at once, if free from adhesions, by means of a corkscrew, or by any method of traction which seems most easy. A piece of gauze spread over the tumor is found very convenient in preventing it from slipping away from the hands of the operator. A large piece of gauze is now put in the abdomen over the intestines, and the sides of the incision above the tumor are often fastened together by catch-forceps, or by a temporary stitch, to prevent the intestines from protruding and to keep them clean and warm. The tendency of the bowels to protrude varies in different patients. In most cases the intestines lie still and quiet. In others they seem to leap out of the abdominal cavity whenever they get a

chance. If in the process of lifting the tumor out of the abdomen adhesions are discovered, it is best to secure them by clamp or ligature, or to pass an elastic ligature around the neck of the tumor of the uterus to prevent hemorrhage. This last procedure is rarely necessary. When the broad ligaments are seen, I tie the left one first, passing the ligature low down and close to the uterus by means of Cleveland's needle, being most careful not to perforate the bladder; then I tie another ligature about an inch further away from the first, toward the ovaries and beyond the tube, or beyond the ovary and the tube, and divide the broad ligament between them. The tube, if left intact on the uterine side, prevents infection from a source to which the patient would be exposed if the tube were opened. I leave the broad ligaments as long as possible, so that my seam over the stump, when the operation is finished, will be a short one. I do not care whether the ovary is tied off or not, nor do I necessarily remove it, for it is well supplied with blood from the ovarian artery, and will not slough when its uterine connections are cut off, and, in fact, may be well enough nourished by adhesions; besides, if it remains, perhaps the physiological symptoms, which are often annoying after removal of the ovaries and uterus, the so-called "heat flashes," etc., may not occur if the ovaries are left, for the ovaries are the reigning powers in the generative organs. The expression should be, "the ovaries and their appendages," not "the uterus and its appendages." The uterus and vagina are simply channels for the nourishment and passage of the ovum and fœtus, the product of the ovary, and serve to expel the infant into the world. In cases of imperfect development the vagina may be wanting, or the uterus may be wanting; but their absence does not imply that of the ovaries. If the latter, however, are wanting, the other organs, I believe, always are. I now go through the same process on the right side, and then make a circular incision through the peritoneal covering of the uterus in front, about two inches above the outline of the bladder wall, which can usually be plainly made out by slight pressure without passing a sound into the bladder, and the same distance above the rectum behind, the

two incisions meeting on either side where the broad ligaments are tied, exactly as one would make a circular incision for the amputation of the thigh. These peritoneal flaps I then turn back. By not getting beneath the peritoneum into the muscular tissue of the uterus the separation is easy and bloodless; but if at all deep, it is difficult and hemorrhagic. The uterus above the internal os has now been denuded of its peritoneum, and is ready to be divided. I then look or feel for the pulsations of the uterine arteries unless they have been tied from the vagina, and if I find them easily (and they are quite superficial) I tie them by passing a ligature of silk around them with an aneurism needle, each one separately; but if I do not find them easily, or if there is a hemorrhage going on, from my flaps having been too thick, I encircle the uterus at the denuded point with a strong, small, solid cord of rubber, and having tied it securely, I cut the tumor and uterus away, and later secure the uterine arteries at my leisure. I now trim away the uterine tissue by a slanting cut in front and behind, the apex being at about the level at which the uterine arteries have been tied. I cauterize very thoroughly the uterine cervical canal at once, as soon as it is opened, with Paquelin's cautery. I always pass the point through the mouth of the uterus well into the vagina and allow it to remain there several seconds. The cauterization must be so thorough that the opening remaining will be large enough to act as a drain for the sloughing which always follows the application of a hot cautery, otherwise the external os may get occluded by the swelling which naturally follows any injury to living tissues; an infection from the sloughing mucous membrane might work its way back and contaminate the stitches by which the abdominal end of the stump is closed, and perhaps also the space lying between the stump and the peritoneum. One of the advantages of the closing of the peritoneum is that even if this blind space does get infected and an abscess is formed, the peritoneal cavity is not infected, and only a localized collection of pus is formed, which may open spontaneously or be opened from Douglas's cul-de-sac. This I have never been obliged to do, though nature opened such an

abscess for me once. There was good drainage, however, and with hot vaginal douches the trouble soon ceased. Next I sew the muscular walls of the neck, by a continuous suture of silk, over the cervical canal, so as to shut out the neck from the abdominal cavity. In sewing the sides of the stump together, it is important that the silk be put through healthy tissue and not allowed to pass through the tissue which has been cauterized, as this must slough away, and in this way the silk might get infected and cause an abscess or a discharge from the ligatures. I then sew the peritoneal flaps together by a light continuous suture over the stump. I always use the fine English braided silk, No. 4; for this suture I do not dare trust to the aseptic qualities of catgut. You will see that although this method is called intra-peritoneal, it is really extra-peritoneal, even more so than the plan by which the neck is constricted by the wire and held outside the skin of the abdomen by a pin across the abdominal wound. I next turn my attention to the ovarian and round ligaments stumps and tie the ovarian arteries again separately. If the ovaries have been removed in whole or in part I decide whether to remove them more completely or leave them. There is now a sutured line running across the lower part of the pelvis, and if there is no oozing the abdomen is emptied of the pieces of gauze which have been put into it, the patient is lowered into a horizontal position, the omentum is pulled down, the intestines descend to their normal place, and the abdominal wound is closed with silkworm-gut sutures without drainage. The flannel suit is left on the patient twenty-four hours or more, according as seems best. The convalescence is like that after a simple ovariotomy. The patient is generally up and about on the fourteenth day, and goes home by the end of the third week. This rapidity of convalescence is in great contrast to that following the treatment of the pedicle by the clamp, which latter method should be entirely discarded.

The technique of complete hysterectomy, "pan-hysterectomy," for fibroid tumors will vary from the above-described operation only in the fact that the os and the neck are separated

wholly or in part from the vaginal wall, preferably by the thermo-cautery, before we begin our abdominal dissection. "The removal of the uterus in total extirpation will be made much more easy if the end of a long pair of catch-forceps is pushed forcibly against the uterus posteriorly in Douglas's *cul-de-sac*, and there fastened. After the abdomen is opened this protruding point can be cut down upon and the vagina easily and readily opened." This manœuvre was suggested by Doyen, of Rheims. At the close of the operation the vaginal walls are sewed together and the peritoneal flaps, which we have separated anteriorly and posteriorly from the uterus, are lightly united by a suture of very fine silk. I never use catgut, as I have found it difficult to make it aseptic, and I have never had trouble with silk. I have usually done the vaginal part of the operation first, but I can see that there are advantages on the side of cleanliness in doing it at the close of the operation rather than at the beginning. Usually I remove the uterus completely at the present day, and do not leave neck or os, as I have once or twice found the organ affected with cancer, and the time taken in doing the vaginal part of the operation, as I have already said, whether from above or below, is no longer, if it is as long, as the time taken in sewing up the uterine canal.

The technique in cases of prolapse and of inversion is exactly the same as the method first described for the simplest cause of removal when the case is not one of cancer, except that one must be more than ordinarily careful about injuring the bladder, and then often one must subsequently do an anterior and probably a posterior colporrhaphy in addition to the hysterectomy, or else sew the vesical part of the vagina to the round ligaments. In all the cases where an opening has been made from the vagina into the peritoneal cavity, gauze should be put in the vagina at the close of the operation, to act as a drain, and where compressing forceps have been left upon the broad ligaments the gauze should be wrapped around them to prevent abrasion of the neighboring parts.

Two cases will illustrate the kind of case mentioned under the sixth head (infected uterus) of the list of conditions in which

hysterectomy is necessary. The first one was that of a married lady, thirty-four years of age, who had been married twelve years. She was well until one year after marriage. She had had no miscarriage. When she had been married six years she was confined with a stillborn child, and was delivered with instruments; was sick in bed six months. A year later an abscess formed, and was supposed to have discharged into the uterus. The abscess is said to have gathered once a month for four months, on one side or the other. Subsequently she had been curetted several times. She had been in bed for three months when she came to me in November, 1895, and said she had had discharges of blood and pus from the rectum several times. Two years before this she was in a nervine asylum. She had considerable pain and tenderness in both iliac regions. I operated by the abdominal route on November 23, 1895. The uterus and tubes were thoroughly adherent, and their outlines could not be easily made out. The tubes only were removed. She recovered rapidly from the operation, and gained flesh, strength, and activity, and considered herself remarkably well. She left the hospital at the end of about three weeks remarkably active, and feeling perfectly well. She had no pain, but there was some discharge from the uterus. Two weeks later, having been walking a good deal, she began to have backache and headache; the uterine discharge became more profuse, and she had so much pain and discomfort that she re-entered St. Margaret's Home, and on January 21, 1896, I removed the uterus by the vaginal route, using clamps to secure the vessels. She has been perfectly well ever since, is very active, and is entirely relieved of her pain and distress.

Another case was that of a woman, thirty years old, who had been married fifteen years. She had been well until a miscarriage, which occurred about twelve years before I saw her. This was followed by double salpingitis. Five years later the ovaries and tubes were removed on account of chronic salpingitis, and were found to be very purulent. She recovered from the operation and gained flesh and strength, but her pain returned, and became so excessive in her abdomen and back, with an abundant

discharge from the uterus, that she decided to undergo an operation, and I removed the uterus by the vaginal route. There was considerable hyperplastic endometritis, and a small polyp about three-quarters of an inch long was found at the opening of the right Fallopian tube. This condition of things was probably the cause of the bloody discharge. She recovered rapidly, and has since been relieved of her pain and discomfort.

The operation for the cure of puerperal sepsis should, as a rule, be done by the vaginal route, using clamps to secure the vessels, as these insure good drainage. Should the diagnosis of general peritonitis be made, the abdominal route should be followed, and the peritoneal cavity should be thoroughly washed out and drained.

After every hysterectomy, for whatever purpose done, a Jacques's self-retaining catheter should be put in the bladder for a few days.

On the whole, the best operations for large fibroids should begin with free separation of the vesical and rectal walls preferably by the cautery in the vagina, accompanied by ligature of the uterine arteries, if these are easily found, to be followed by laparotomy and removal of the tumor through the abdominal wound.

DISCUSSION.

Dr. Vander Veer, of Albany, N. Y.

The subject that has just been so thoroughly presented by Dr. Homans is one that commands our most careful consideration. It matters not what may be said to our credit by confiding brethren within our profession, as to operative skill and ability to invade these anatomical structures when pathological changes present, and to carry our patient safely from the operating-table, even though the detention may have been long and anxious, to the recovery and convalescent bed, or to listen to the indorsement of the intelligent laymen as to what wonderous results modern surgery, asepsis, and trained nursing are able to accomplish in these days; the fact, nevertheless, remains that when we view the situation calmly there is not, on many of the questions as presented by Dr. Homans, such a consensus of opinion by those in our profession who are doing this kind of work, as to release us from a full and free discussion. One has but to study carefully the medical literature of the day, to watch with candor the discussions in our many societies and associations, to observe closely the treatment and variety of operations as performed by our ablest honest surgeons, to realize that we have not yet reached a common basis on which we can apply our remedial effects on lines precisely alike. Possibly we may never need expect such precision, nay, it can hardly be expected when the inventive skill of this or that surgeon brings into use an array of new instruments, appalling to the plain, simple, but heroic surgeon, who is a positive defender of methods free from artful demonstrations. But it is by the handling of these surgical questions in the manner offered by the essayist that we come nearer the truth and leave for those who are just entering upon this work, and who are to follow us, a clearer view of the situation. Whether this or that patient is to have a more comfortable existence by being let alone from a surgical standpoint, or whether this or that procedure is to be for the best; whether this operation is to give her a more comfortable lease of life or a radical recovery, is the important question. It seems to me we are reaching the milestone in this kind of surgery, when we must observe in a dispassionate manner and study with candor our results. If we are candid with ourselves, are there not moments when we ask the

question, "I wonder if my patients make as good and permanent recoveries as do those of my fellow operators?" And then does there not come, perhaps in one short month, the reply in our consultation work, in seeing those who come in the convalescent period after a skilful operation by surgeon A, B, or C., and who say frankly, "I am not so well as I hoped to be," or, "I fear my disease is returning." Do we not at times promise too much?

I think in the first division presented by Dr. Homans, when correction of misplacements, when curetting, and all intelligent lines of practice have been, without recovery, carried out, we can fully agree with him that removal is the proper procedure, and that these are the cases that bring us such good results, though a minority operation. These are the cases that are classed on our credit side by the grateful, enthusiastic patient. As to the method of removal: I am firm in my conviction that if the vagina is normal or comparatively so, if the cervix, particularly the external os, is in a healthy condition, the abdominal or supra-vaginal hysterotomy commands my judgment and gives the patient a degree of normal vaginal anatomical relations that is comforting and beneficial to her. At the same time it gives me an opportunity to examine the pelvis from above, to relieve adhesions, bring under positive observation the tubes and ovaries, and if not healthy to remove them, especially so if the operation is one previous to the menopause. After this change I do not feel so anxious as to leaving behind the uterine appendages.

If the condition is one in which we have present decided cystocele or rectocele, or prolapse of one or both ovaries, then the vaginal route is to be preferred. The employment of some degree of plastic surgery just now will be admissible. The vaginal outlet of the pelvis can be mended to a degree of comfort for the patient. It may not be out of place to introduce here the discussion as to the use of the clamp, the ligature, or the forceps. If it be the abdominal operation, by all means avoid the clamp, though the elongated cervix may be ever so great a temptation to its use in doing a quick operation. Rather by far a few ligatures and a completed retro- or intra-peritoneal treatment, with or without ventral fixation, as the individual case may require. If it be the vaginal route and sufficient space, the silk ligature aseptic cut short. If little space, then perhaps a few forceps or such as may be necessary. Vaginal surfaces in these latter cases will fall together and heal properly. In all these cases no drainage in my experience is equal to that of properly prepared iodoform gauze. Not too

much douching after the operation, but when needed used intelligently and thoroughly, douche-pan, etc.

In the second division, for malignant disease; when we consider the possible number of cases in which the uterus has been removed for supposed malignancy; when we study our cases of correctly diagnosed malignancy by examination of removed specimen as to their career, in which an operation has been positively refused, and have seen them live on, in some cases almost up to or beyond the allotted period of one or two years of comfort; when we consider the rapidity with which the disease returns in some cases, and the shock and suffering of the immediate operation and the discomfort following this surgical interference, I am sure we have much, very much, to claim our careful attention in the discussion of the subject. Alas, if we could but be brought into the case when the indications first present. If the old expression, "supposed change of life," "a return of an old leucorrhœa," "exhaustion following some serious illness," "not yet well from her last confinement or miscarriage," these and many other excuses could be done away with, and the patient present her case to her up-to date family physician, and then promptly be transferred to the consulting surgeon or gynecologist, more could be accomplished. I am sure that of the cases brought to me during the past fifteen years, that during the first ten years of this period I saw a greater number that had passed the limit of proper indications for the operation of removal than were the cases in condition for hysterectomy. During the past five years conditions have improved, and I am just in saying that the family physician, the general practitioner, is much more alert, while the patient herself, intelligent or not, is much more observing and willing for an examination, an early diagnosis, and prompt radical treatment. My own study of these cases of carcinoma of the cervix is, that if the disease has advanced away from the neck of the uterus, other tissues implicated outside of the cavity and body of the organ, then the indications are against hysterectomy, vaginal or otherwise. If confined to the uterus, all suspected symptoms and indications having been confirmed by microscopical examination of removed specimen, then an operation is called for. In saying this I do not wish to be understood that when the disease is yet small and limited, confined to the cervix, lacerated or not, that I am willing to suggest or urge upon this patient a complete removal. I have seen too many cases recover under a partial or high amputation, by scissors or thermocautery, to keep me from going ahead too severely in the requirements

of a complete operation. This may not seem orthodox, coming from one accustomed to remove other organs completely, invading, without hesitation, the axilla, inguinal regions, angles of the neck, and similar portions of the body to complete an operation. I have seen so many invalids, not only among my own patients, but from the hands of far better operators, that I am perhaps overcautious in recommending a complete hysterectomy. It must be remembered that from the early operation of Freund this question of removal of the uterus for malignant disease has been under constant observation, and I have watched and studied it in all its bearings. Treatment by thermo-cautery caustics, removal after one method and another, has not escaped my personal attention. Early return of the disease, possibly an earlier complication of the bladder or rectum fistulous-fecal tracts connecting with the small intestines, strictures, etc., from surgical interference, all have made their impressions, and I may be excused if I am not over-enthusiastic in indorsing hysterectomy so earnestly as some of my younger brethren. However, when for any reason there is the least doubt in my mind as to the milder procedure being the wisest course, then am I earnest and emphatic in recommending and doing the radical operation. As to the technique here employed, when the uterus is not too large from invasion of the body by the disease, when there are no considerable fibroids present, when no pregnancy beyond the third month complicates, then by all means let the surgical route be through vaginal hysterectomy. I would not vary the steps essentially from those just referred to. It is not necessary to recapitulate what I have said in removal of the uterus and its appendages for intractable hemorrhage. When the body of the uterus is the part particularly implicated, when too large to reach by the vaginal route, then there presents a field for careful consideration; when the body of the uterus is strictly the seat of the disease, and the cervix not implicated, and the case can be determined as one of true adeno-carcinoma, I believe we are justified in doing the supra-vaginal hysterectomy, leaving the cervix intact. When, however, the cervix is invaded with a true epithelioma or malignancy of any variety, and the enlarged body of the uterus from any cause is present, then the pan-hysterectomy becomes necessary, and the patient requires the most careful preparation. In many cases a preliminary operation is called for; that is, the previous removal of the diseased cervix by cautery or knife, that the parts may be put in a more perfect condition of asepsis. Then every effort

should be made to make the operation strictly retro-peritoneal, ligatures of silk, and drainage down through the vagina.

Of all the brilliant advances made in my time in abdominal surgery, aside from intestinal anastomosis, nothing has so impressed me as the treatment of uterine fibroids, a pathological condition that upset our early and best operators regarding surgical interference. By the presence of a fibroid I am not willing to admit that it necessarily means an operation. Many patients suffer so little inconvenience from the hard interstitial or subperitoneal forms, not growing rapidly, no hemorrhage, that an operation is uncalled for. Curetting the uterus when there is evidently within it a polypus, and associated with it a uterine fibroid, will answer in a few cases, and I do not think in all cases we should exclude the good effects of electricity, but when the effects or distress of fibroids present, where the location of the tumor is such as to produce irritation of the bladder, is such as to cause pressure upon the bowel, in any form, particularly the rectum, or in some way to produce an occasional threatened obstruction, if the tumor is growing more rapidly and the hemorrhage is becoming more serious with each menstrual period, the flowing being almost constant, or the case being complicated with pregnancy, then we have placed before us but one alternative, and that is, complete removal, which can be done at the present day without great risk to the life of the patient, and ultimate complete recovery. The class of cases in which pain is beginning to present in the small fibroid, in which there is some fear that it may develop into a sarcomatous condition, are also cases that should be brought immediately under the skill of the surgeon. Methods of operation cannot always be determined until the abdomen is opened. To sum up the indications for operation in these cases we may specify them as follows: "Size of tumor, particularly in a young woman; rapidity of growth; development of cystic degeneration; suppuration and sloughing; excessive hemorrhage; obstruction of bowels from pressure; pain, and ascitic fluid."

Many cases where the fibroid is small and there has not been too great evidence of previous pelvic peritonitis, can be removed by vaginal hysterectomy, the operation having many points in its favor; my greatest objection being its destruction of the anatomical vault of the vagina. In doing the abdominal hysterectomy I am strongly in favor of the use of the ligature, leaving the cervix when free from disease, and covering the stump left by ligating the ovarian arteries; in fact, every portion of raw surface, by bringing over these tissues the healthy

peritoneum. If necessary, establishing correct drainage down through the cervical canal into and through the vagina. The necessity of this latter procedure is shown by the manner in which nature sometimes does it for us — an unexpected free, offensive discharge a few days after the operation, normal ideal drainage, and, when properly looked after, never adding to our percentage of mortality. The only exception I would yet make in the use of the ligature in this operation is where we have had a previous history of soft myoma, and when on opening the abdominal cavity we find great venous sinuses on each side of the tumor, spread out over it largely and dipping down into the pelvis, giving all the tissues a spongy, soft, uncertain feel; then to save time and to prevent placing in the pelvis an unusual number of ligatures, I am yet willing to make use of the clamp.

As to the combined operation, pan-hysterectomy, my own experience has been that there are not very many cases requiring it, such indications as when in multiple fibroids, particularly when one is situated in either lip of the cervix, when the external os is hard and suspicious, when a laceration is present showing cystic degeneration, when malignancy is even suspected, then do this operation. As to the technique, great care should be exercised in the preparation of the patient, and the work of separating the vaginal attachment and ligature of the uterine arteries, if possible, done first. This cannot always be done owing to the impossibility of reaching the cervix from below; then no time should be wasted, but the work done from above, and in the manner as advocated by some surgeons, keeping above the vagina, enucleating every portion of the cervix. In doing the pan-hysterectomy we must expect, if the fibroid is of good size, or fastened down in the pelvis by previous attacks of pelvic peritonitis, to give ourselves the benefit of a free abdominal incision. Trendelenburg's position may be made use of or not; but a great help, and to be used early after the incision, is the placing of the broad towels of sterilized gauze, keeping the contents of the abdomen well up out of the field of vision. We then have a good field for liberating the bladder, noting the relations of the ureters, and minimizing our injury to surrounding tissues.

The indication, that of uncontrollable prolapse mentioned by Dr. Homans, I can only agree with him when abdominal incision, shortening the round ligaments, and making a broad firm ventral fixation, has failed. Again, let me repeat, do not take away from the poor

woman any more of her organs than is absolutely necessary, if like good results can be secured by a less severe procedure.

I am glad to see Dr. Homans placing among the indications that of incurable chronic inversion for immediate operation. Clean, intelligent, anatomical, positive surgery is yet to do much good in these infrequent cases.

Regarding cases of infection, the indications are to cure puerperal sepsis; my experience has been that of two cases, too limited to be of any benefit in discussing the subject.

Regarding the advisability of placing a Jacques self-retaining catheter in the bladder after these operations, I cannot advise it. In view of the ease with which the intelligent nurse can keep the glass catheter aseptic, the use of cocaine if necessary, and proper attention in bathing the parts and caring for the dressings, I believe there are only a few cases in which the self-retaining catheter is of real service.

Regarding the technique, special manipulations, preparation of patient, and other considerations referred to so ably by Dr. Homans in this kind of work, I am sure we all agree with him. We cannot be too thorough, and yet how much that is vital rests with our honest, faithful nurse.

Dr. Henry H. Mudd, of St. Louis.

Hysterectomy for fibroid tumors has a technique which is not uniform, and which varies with the special indications. Enucleation of fibroid tumors is becoming more common, and will in a measure limit, in skilful hands, the number of cases of hysterectomy for this condition. I wish specially to express gratitude at the preference Dr. Homans shows for discarding the clamp.

Hysterectomy for acute puerperal sepsis is justly growing in favor. Hysterectomy for suppurative periuterine inflammations should, I think, be strictly limited to a very narrow field of action. It is now frequently performed by certain operators. It is a conservative and necessary operation in a limited number of cases—cases which should diminish in number as the treatment of pelvic inflammations comes to be more promptly enforced. The technique of this radical procedure is not sufficiently familiar to me, in clinical work, to permit me to discuss it.

I shall consider in this brief discussion the technique of hysterectomy for malignant disease. This will involve the consideration of both abdominal and vaginal hysterectomy.

Vaginal hysterectomy for malignant disease is efficient and desirable for those cases where the disease is limited to the external os; that is, to cases where the disease finds its origin in the os and the case comes early under operative treatment.

The extension of carcinoma of the os is by infiltration of new tissue in two directions: first, along the vaginal tissue; and, second, into the broad ligament. Wherever the extension of the disease into either of these parts is marked it appears to me that the ability to outline and to cut free of the infiltrated tissue is much greater by the abdominal route than by the vaginal. Many cases may be profitably subjected to abdominal hysterectomy which are too far advanced to be attempted by the vaginal route, for it is not necessary to follow so closely the outline of the uterus when cutting from above, as it is when you advance from the vagina. The upper segment of the anterior wall of the vagina can be much more freely and safely excised after detaching the bladder from it than it can be from the vaginal side. This is also true of the broad ligament and the posterior vaginal wall. Extensive involvement of either the broad ligament or the vaginal wall means that the time for a radical operation has passed.

Most of the cases in which the malignant growth begins in the body of the uterus, or where it is much enlarged, should be subjected to abdominal hysterectomy. This is certainly the only method of operation where the uterus is secondarily involved, the primary growth being found in the ovary or the tube.

The greater number of cases of malignant disease which require hysterectomy have their origin in the os, and if presented early to the operator may be removed by the vaginal route. Clinical experience indicates, however, that many of these cases are so late in seeking operative relief that a large percentage of them are so far advanced that they are either inoperable or are best treated by abdominal section.

The preparation of the patient for the operation is in accordance with general rules. Rest for a few days should be enforced—the bowel should be thoroughly emptied; the kidneys are to be interrogated, and the privates and the vagina should be cleansed before the patient is put upon the table. I like to have the patient anæsthetized upon the operating-table, in order that the time necessary for the anæsthetic may be as short as possible. It is important in all operations that every preparatory step which will limit the duration of anæsthesia should be carefully and uniformly exacted before the patient comes to the

operating-table. The table used in these operations, as in most of the capital operations, should be of wood, not glass or metal; for the abstraction of heat from the body by the glass or metal plate must necessarily add to the shock inflicted upon the patient. The technique involves, of course, the antiseptic preparation of the abdominal wall, the vagina, the hands and the instruments.

Where the carcinomatous growth is soft or pliable and involves the os, it should be curetted, and the soft portion removed before the abdominal section is made. The margins left after curetting away the soft portion of the growth, should in many cases, be drawn together with a continuous suture of silk, so as to avoid any oozing from the parts that may contaminate the peritoneal cavity by the passage through it of the uterine neck and os as it is removed.

This operation may be done with the patient on the ordinary operating-table or in the Trendelenburg posture. I prefer the Trendelenburg position. The abdominal incision should be free enough to give room for rapid and accurate work. It should have the lower end at the pubis, and is ordinarily four or six inches long. One broad retractor placed in the lower angle of the abdominal incision and an occasional use of a lateral retractor give easy access to the field of operation, for the eye as well as the hand.

The ovarian artery and the round ligament are then ligated on each side. A single ligature of silk is generally sufficient; if they are separately ligatured, catgut may be used. The ligatures are very generally so placed that the ovary and the Fallopian tube are removed with the uterus. A pair of forceps are then placed on each side of the uterus, so as to clamp the tissues of the broad ligament near the lateral border. The tissues are then divided with the scissors, so that the line of division falls inside of the ligatures. The section should extend well down to the neck of the uterus. A strong volsellum is now fixed in the uterine body, and is pulled up out of the pelvis.

An incision is then made with the knife along the vesico-uterine fold. This should extend from one broad ligament to the other, and unite the lower angle of the incision in the broad ligaments. The bladder is then detached from the neck of the uterus and the upper part of the anterior wall of the vagina. The uterine artery is now easily exposed by pushing aside the peritoneum and loosening the connective tissue about it.

A curved needle with a catgut ligature should be passed round the artery after it is exposed. In order to define the artery by pulsation

it may be necessary to relax the tension of the parts made by the pull on the uterus with the volsellum. I do not think it often necessary to seek to define the ureter, though it may be exposed if it is in danger.

A knife or a pair of scissors can now be thrust into the vagina, in front of the uterine neck, at the desired point. The opening in the anterior vaginal wall should be enlarged transversely until it will easily admit the index finger. A pair of long-handled scissors, curved on the flat, should be then used for severing the tissues about the neck of the uterus. The index finger of the left hand passed to one side of the uterus serves as a guide for the line of section that it is desired to make with the scissors. It pushes aside the ureter, and puts on the stretch the tissues in which the uterine artery is imbedded; and, most important of all, it defines by the touch in the vagina the line of the incision that it is desired to make through the sound and healthy tissue. After separating the tissues on one side it is carried to the opposite side, and the tissue of the broad ligament severed from before backward, as before described. It is not often necessary to save more of the peritoneum of the recto-uterine pouch than can be obtained if it is severed with the vaginal wall, as the scissors divide it in severing the vaginal connection from the posterior surface of the neck of the uterus. The finger in the vagina should also determine the line of this incision. The detachment of the neck of the uterus from its vaginal connection is thus quickly and safely made. This method of freeing the uterus from its vaginal attachments is more satisfactory and expeditious than if we enter the vagina through the recto-uterine pouch.

The operation is now easily completed by placing a loose, not very large packing of gauze in the loose tissue between the vaginal wall and the peritoneum. The peritoneal margins are now approximated by a continuous suture. The peritoneal cavity is then cleansed and the abdominal wound closed. Good union of the abdominal wall can, I think, ordinarily be obtained by the use of a single line of sutures which should include both peritoneum and skin surface. Patients where the line of incision includes a thick wall of fat are, I believe, made more secure by a double row of sutures; one placed deeply, includes the peritoneum and the muscular wall, the other should include the skin and the fatty tissues and some of the firmer tissue of the abdominal wall.

The vagina should be cleansed before putting the permanent drain into it.

The shock from vaginal hysterectomy is less, the danger to the

patient is diminished, the recovery is more prompt, and the danger of ventral hernia is excluded. Where the diagnosis is clear and the case favorable for this operation, it is a desirable one for being expeditious and comparatively safe.

Vaginal hysterectomy requires the same general preparation. The patient should be in a dorsal position, with the thighs flexed on the body, and the legs suspended or flexed on the thighs. This gives easy access to the parts, and enables the surgeon to keep his landmarks more accurately in view. If now the growth is so firm as not to be broken down by the necessary manipulation of the os and neck, the surgeon is ready to sponge out the vagina with a gauze compress and to proceed with the extirpation.

If, however, the growth is soft and pliable, it should be cleansed with a curette, washed with sterile water, wiped with a gauze sponge, and the firmer margins approximated by sutures or by the grasp of a strong volsellum. The uterus having been seized with a strong volsellum, is pulled down. Two retractors are useful. These should be shifted during the steps of the operation, so that one of them should retract the anterior or posterior wall, as desired by the operator, and the other is used to hold aside the lateral wall when the operator is seeking to divide the tissue at the base of the broad ligament. The first incision should be behind the neck of the uterus, near the uterine tissue. It must be deepened until the peritoneal pouch is reached. The peritoneal cavity is entered, and the opening should be made sufficiently large for the finger to be passed into the peritoneal cavity. The incision can be enlarged transversely easier and quicker with a blunt-pointed bistoury. The finger serves as a guide ; the ends of the transverse incision should go well to one side of the uterus, coming close up to the base of the broad ligament posteriorly. Place a gauze tampon over the section in the posterior vaginal wall so that it will rest in the peritoneal cavity. This prevents oozing of blood into the peritoneal sac. The neck of the uterus is now pulled backward, and the division of the vaginal wall on the anterior surface of the neck is commenced. The operator should keep close to the tissue of the uterus until he gets through the dense tissue of the vagina. The finger is then used to detach the bladder from the neck of the uterus. The peritoneal pouch in front of the uterus is then opened. The tis ues at the base of the broad ligament on the vaginal surface are then divided until the uterine artery can be felt and secured by a ligature. This ligature may be passed with a pedicle needle, and should ordi-

narily be of catgut. If much tissue is included in this ligature, it is better to use silk, and leave one long end of the ligature in the vagina. The ligature is most easily passed about the uterine artery when the neck of the uterus is pulled downward and backward, the finger serving as a guide to the pedicle needle as it is passed from behind forward through the tissue of the broad ligament.

A pair of long handled scissors are now used to divide the tissue at the base of the broad ligament. When the parts upon both sides are free the uterus can be readily pulled down, so as to give access to the upper portion of the broad ligament—that is, to the ovarian artery. The tubes and the ovary upon one side are now exposed, and, if it is desirable, they can be removed after placing ligatures outside of the ovary, so as to include the ovarian artery and the upper segment of the broad ligament. If it is difficult to place such a ligature, a clamp may be used to enclose the upper section of the broad ligament and allowed to remain for thirty-six to forty-eight hours. It does not appear to be essential that the ovary and the tubes should be removed in every case.

If a ligature is to be used in securing the ovarian artery, it should be of silk. It may be cut short or left with one end resting in the vagina as the operator may think best. If the operation has proceeded with satisfaction, it is usually safer to cut it off short. Hemorrhages should be well controlled by ligatures or clamps. The vagina should be thoroughly cleansed again, the wound surfaces sponged dry, and a gauze compress placed in the loose tissue, with its lower end resting in the vagina.

I have discarded iodoform gauze in all cases where it comes in contact with the peritoneum. It is a dangerous agent. It is liable to increase the depression of shock, and may determine nephritis, and by the marked depression it occasionally produces may turn the tide against the patient.

DR. FREDERICK E. LANGE, of New York.

I shall limit my remarks to those exceptional cases in which serious technical difficulties arise through the broad insertion of the parts to be removed in the pelvis, and I shall take as paradigma those large subperitoneal fibro-myomata, the eradication of which is so desirable, though one of the gravest surgical tasks. Our modern accomplishments will enable us to deal successfully with these cases, if only the two cardinal rules are observed: limitation of hemorrhage and avoid-

ance of infection. It seems superfluous to emphasize that, still our technique ought to be directed entirely toward these two indications. It is by no means easy to keep up strict asepsis during an operation extending over three or four hours, and it requires most scrupulous and careful work to avoid hemorrhage of dangerous degree. In the latter respect it is pre eminently important to see what one does. Working in the dark and the application of force in regions one does control, are strictly contraindicated. It is preferable to proceed slowly and safely, than to hurry with uncertainty. The danger of shock in these cases is not so very great as long as the patient does not suffer undue loss of blood.

Considering the desirability to secure as early as possible the main vessels, I have with advantage in a number of my cases resorted to Bardenheuer's cross incision above the symphysis and parallel to Poupart's ligaments. I admit that this incision prolonged somewhat the operation, but it offers the advantage that the outline of the bladder can be seen from the beginning. The field of operation is more accessible, and one is able to work away behind the peritoneum toward the uterine artery and to ligate it sooner than after longitudinal incision. One disadvantage of this incision is, that the fleshy portions of the musculi recti will not offer a solid resistance for the buried sutures. As a rule, these patients have never been pregnant, and the retraction of the muscle is very intense. I, therefore, in my last case, by means of a broad chisel severed the upper edge of the pubic bones corresponding to the attachment of the recti, and in reuniting the parts achieved accurate adaptation of broad bony surfaces. In this case the operation had been tried once before with longitudinal incision, and a broad scar was fixed to the anterior surface of the tumor. This scar had to be excised, and a longitudinal cut was therefore added to the lower cross-incision, the final scar thus forming the shape of an anchor. The tumor of the uterus was complicated with cystic degeneration of the ovaries, and the difficulties were extreme. The operation lasted fully five hours, and still the patient made an excellent recovery. To secure reservoirs of blood, her four extremities were tied off, and at last a free saline infusion was administered. The raw surfaces remaining in the pelvis must be covered as much as possible by approaching the cut edges of the peritoneum. In one case I used the broad omental apron, which I affixed to the posterior surface of the pubic bones in order to prevent the agglutination of the intestines to the denuded anterior abdominal parietes.

In one of my cases I had an unfavorable result due to the bursting of a septic focus in the depth of the pelvis. I was not prepared for this occurrence, and the patient died several days later from septic peritonitis. In three other cases the patients made good recoveries with firm and good scars, and though I have, by longitudinal incision, successfully removed quite a number of these tumors with broad insertion, I am inclined to regard, in the extremest cases, the cross-incision, adding if necessary a longitudinal one as preferable, bearing in mind the greater accessibility to the deeper portion of the field of operation, and thereby the greater certainty of our technical doings.

One word with reference to vaginal extirpation of the uterus. I think we all agree that the difficulties in these cases vary in wide limits and that those cases in which the uterus does not follow to traction, and the parametria are unyielding, may be extremely tedious and sometimes unsatisfactory.

In 1894 Dr. Schuchard, of Stettin, described the so-called paravaginal method, which consists in severing the soft parts alongside the rectum and laterally into the vagina to its entire length. This incision gives, indeed, good access to the floor of the pelvis, and I have availed myself of it to great advantage in about ten cases, being I think the first who practised it, my first case dating back to November, 1892, which is about one year prior to the first one operated upon by Dr. Schuchard. Patient was a woman about twenty-eight years of age, on whom various attempts had been made to remove, by laparotomy, a tense suppurating cyst, deeply imbedded in the floor of the pelvis. The incision is no doubt an addition to the gravity of the operation, hemorrhage being by no means insignificant. But it may be reasonably limited by securing the more important vessels, if possible, before they are cut across. Especially near the introitus of the vagina and its posterior portion their technicality will be found useful on account of the great vascularity of these regions. With the proper free cross incision into the posterior cul-de-sac the access to the uterus and parametria will be as free as possible, and I regard this method as quite as commendable where it is indicated. All of my patients have made very good recoveries. In regard to the possibility of infection in suppurating cases it offers the advantage of drainage away from the peritoneal cavity. Lastly I may be allowed to mention the sacral method as the one indicated, where we need especially free access to lateral regions of the uterus. I have practised it in a limited number of cases, and was once able to preserve the life of a patient for almost

three years in spite of the fact that at the time of the operation the parametria had to be removed extensively. With comparative certainty I was able to shell out the ureters and to avoid them.

To give strict rules for operative indication in cases of malignant disease is hardly possible. What we call carcinoma today varies so much in character and development that probably widely different pathological processes are put under the same heading. We see the same thing in cases of cancer of the breast. Occasionally they will be so far gone that an operation seems without value, still it will prolong life for years. In other cases a radical operation in the early stage of the disease will be followed by speedy local and general recurrence.

Dr. Dudley P. Allen, of Cleveland.

The method of Doyen, of Rheims, which has comparatively recently been introduced as a method of performing hysterectomy, is of sufficient value to be worthy of mention in this discussion. The patient is placed in the Trendelenburg position, the uterus is drawn forward over the pubes, and an opening is made from the abdominal cavity into the vagina through Douglas' cul-de-sac. Long forceps are inserted through this opening, the cervix is seized and drawn upward into the abdominal cavity, and the right broad ligament is divided between the uterus and ovary. No ligatures or forceps are applied, but the broad ligament is seized by an assistant and compressed, and the bleeding is thus controlled. The cervix and uterus are drawn upward and rotated posteriorly and to the left, and, by successive cuts with the scissors, the uterus is separated from the bladder anteriorly, and finally from the left broad ligament, the left ligament being held by an assistant as was the right. The individual arteries are then secured by hæmostatics and ligated. The floor of the pelvis may then be closed by a transverse suture, uniting the peritoneum, or drainage may be established by means of gauze drawn from the abdominal cavity into the vagina.

The method is a most brilliant one, and the time required for the operation is very short, a few moments only being necessary for the removal of the uterus. The amount of blood which is lost by this method is less than by any other I have ever attempted.

THE ROENTGEN RAYS IN SURGERY.

By J. WILLIAM WHITE, M.D.,
PHILADELPHIA.

During the period of development of any new process of exploration or method of treatment it is useful from time to time to sum up the results accomplished, and to compare the views of various workers in the same field. It has seemed to me that a paper on the Roentgen rays, to be of interest or value to this Association, should not be an attempt at an exhaustive review of all the clinical work that has been done by this method, but should rather present for discussion a series of conclusions based upon such work, or of questions suggested by it. I have, therefore, not attempted to prepare a formal paper, but for the sake of bringing the subject up for consideration have tried to formulate tentatively, and as concisely as possible, the present state of our knowledge as to the surgical applications of skiagraphy, with the hope that my conclusions may be corrected or supplemented by the experience of other members of the Association.

The subdivisions of the subjects are naturally partly clinical and partly anatomical. I shall take them up seriatim, following in a general way the chronological order of their development, and beginning with

Foreign Bodies.

(*a*) It is now possible to say, dogmatically, that substances more opaque to the rays than the tissues by which they are surrounded, and situated in the limbs, the walls of the chest, abdomen, or pelvis, in the neck, the scalp, or the bones of the

cranium, can be discovered and located with entire accuracy by skiagraphs taken from two or more directions.

A single picture, while conclusively demonstrating the presence of the intruder in a given locality, may readily be very misleading as to its exact relation to important structures. If any considerable period has elapsed between the taking of the skiagraph and operation, the frequency of movement of foreign bodies in the tissues should not be lost sight of. In one case of my own a needle was shown a quarter of an inch beneath the skin over the upper end of the tibia in a young child. A week intervened. At the operation a distinct induration was felt at this point. On cutting down upon it no needle was to be found there. It was discovered, after a careful dissection, lying beneath the periosteum at the side of the tibial tubercle. Examples of this well-known mobility of foreign bodies might easily be multiplied. Mr. Turner, of King's College Hospital, has recorded a case (*The Lancet*, June 30, 1896) in which, after six skiagraphs and three operations, a needle in the sole of the foot still eluded the operator. In such instances, the possibility of the foreign body having gained access to a tendon-sheath should be remembered. If it is very small and fine, it might easily be there and escape recognition by touch while search for it was conducted throughout the whole neighboring region.

Dr. Walsh has found (*British Medical Journal*, March 27, 1897) that in those parts of the body where surface-markings exist, these markings could be reproduced in a skiagraph by rubbing a little powdered oxide of bismuth into the creases of the skin. He has suggested that in this way a complete surface map, with numerous lines of latitude and longitude, could be made available as a guide to the knife of the operator who is searching for a very fine and easily overlooked foreign body.

(*b*) *In the cavities of the body* foreign bodies can be located by a system of triangulation by means of successive skiagraphs having known relations to one another and to a fixed point on the surface of the body next the plate. Exner (*Wien. klin. Woch.*, January 7, 1897) has described a process by means of which he has been able to locate bodies on the fluorescent screen. He

places the lamp on one of two graduated arms at right angles to each other, one being perpendicular to and the other parallel with the screen. Measurements are made by pieces of lead sliding upon the perpendicular arm of the stand. Their projection upon the screen determines both the size and the location of the foreign body.

The method seems reasonable if views from different directions are taken, but it is open to the objection that in planning an important operation the surgeon must either depend entirely upon the testimony of some one else or take the large amount of time required not only to make such examinations, but also to acquire technical familiarity with the apparatus. If a series of skiagraphs is made, they can be studied at leisure, and a permanent record can be kept.

In the *cranial cavity* bullets have been located and removed. The recognition of the bullet seems likely to be easy in the majority of cases. In one of my patients a bullet under the scalp was skiagraphed from the opposite side of the head, the rays thus passing through two thicknesses of cranium as well as through the scalp and the brain tissue. The localization is far more difficult. The system of triangulation will probably apply here ; but, of course, clinical symptoms and other methods of exploration, as the telephonic probe, which was used in a case of Fowler's (*Brooklyn Med. Journ.*, 1896, p. 755), will always be valuable aids, and at present are almost indispensable.

The fluoroscope has in some instances been more valuable than the skiagraph, bullets being easily seen which could not be made to appear on a negative even after an exposure of an hour, as in a case of Bruce's (*Medical Record*, April 17, 1897). I have found it useful to indicate on the scalp by means of lead wire or lead paint the important localizing lines, as those of the fissure of Rolando, the fissure of Sylvius, Reid's base line, etc., so that the relation of the foreign body to these lines can be at least approximately estimated.

Scheier (*Deutsche med. Wochen.*, October 1, 1896) reports a case in which a bullet was located in the neighborhood of the Gasserian ganglion five years after it had entered the cranial

cavity through a wound just above the outer end of the superciliary ridge. A skiagraph at the time of the accident would have prevented an unnecessary exploration of the orbit which was made at that time.

Eulenberg (*Ibid.*, August 17, 1896) reports two cases, in each of which a bullet in the middle fossa was shown by skiagraphy.

Brissaud and Bonde (*Semaine Méd.*, June 24, 1896) located a bullet in the second temporal convolution. Other cases have been recorded.

In the *thoracic cavity* bullets can be located with reasonable accuracy in the trachea, bronchi, lungs, or pleura. In the case of a boy who swallowed a tack, Pöch (*Wien. klin. Woch.*, November 12, 1896) first found the body with the fluoroscope; a skiagraph then showed it to be in the left lung on the level of the sixth intercostal space; two positions of the tube demonstrated that it was near the posterior wall of the thorax, as the shadows cast were not very far apart, and did not fall upon the vertebræ even when the tube was carried well to the left. I quote the case, as it gives in brief an idea of a rapid method of approximate localization.

It is worth mentioning that rubber drainage tubes in the pleural cavity cannot invariably be detected by the Roentgen method, but seem to be more or less translucent to the rays. In a case of my own, a very large-sized tube which had disappeared, and was thought to have been thrown out in the dressings, cast absolutely no shadow on the skiagraph-plate, but was easily found and removed by forceps.

There can be little doubt that the difficult decision between operative interference and expectancy in penetrating gunshot wounds of the thorax without wound of exit will be greatly facilitated in the future by the accurate localization of the bullet. I have now under treatment a young lad who accidentally shot himself with a 22-calibre parlor rifle. The ball entered the wall of the right chest on the mid-axillary line in the sixth interspace. The muzzle of the rifle was pointing upward. The patient complained bitterly of pain under the upper border of the right scapula. The history of the case, and all the clinical phenomena

would have led to exploration in that region, but the skiagraph shows the bullet in the lower lobe of the lung on a level with the tenth rib and near the middle line of the body. The picture also shows, in a convincing manner, a pulmonary area (corresponding to the lower lobe) of increased opacity, and evidently the seat of blood effusion and inflammation. The patient has all the clinical symptoms of a traumatic pneumonia.

It is obvious that *in the œsophagus* the cases of detection and removal of foreign bodies will be, as they have been, very numerous and very satisfactory. The accuracy with which not only the presence of the intruder, but its exact situation can be determined, has gone far to resolve the doubts as to the choice of operation, which used sometimes to be very grave ones. As the shape and size of the body can also be determined, the surgeon has all the facts which enable him to decide to make the attempt at removal by forceps or coin-catcher, to do an œsophagotomy, or to remove the body through the stomach All these methods have been successfully employed, and cases have been reported by Péan (*Bull. de l'Acad. de Méd.*, Dec. 9, 1896), Bowlby and Marsh (*Lancet*, Jan. 30, 1897), Raw (*Brit. Med. Journ.*, 1896, vol. xi. p. 1678), (*Ibid.*, 1896, vol. xi. p. 1677), Bull (*Med. Record*, 1897), A. C. Wood (*Univ. Med. Magazine*, Oct. 1896), and myself (*Univ. Med. Magazine*, June, 1896.)

In *the abdominal cavity* the conditions are about the same as in the thorax. If the foreign body is within the intestinal tract it is obviously difficult to determine the exact portion thereof which it occupies. A series of skiagraphs might, however, show such progressive motion as to make it evident that the body would be ejected spontaneously, and might thus demonstrate the propriety of expectant treatment. They would also go far to relieve the anxiety of the patient or the family, which is often extreme in these cases. It does not seem unlikely that in appropriate instances the presence of a foreign body in the stomach could be demonstrated by moderately distending that organ with a harmless opaque fluid, like lime-water, and observing whether or not the body disappeared from view. Neither is it impossible that if the shape and size permitted (as a Murphy

button, for example), the body might, with the help of the fluoroscope, be seized with appropriately shaped forceps and withdrawn through the œsophagus.

Lindermann (*Deut. med. Woch.*, April 22, 1897) demonstrates the outline of a dilated stomach by passing into the stomach a soft stomach-tube armed with a metal mandarin ; this follows the greater curvature of the stomach approximately, and, by marking the umbilicus with a coin, the outline of the stomach can be relatively demonstrated.

Kronberg (*Wien. med. Woch.*, May 23, 1896), arguing from the comparative innocuousness of metallic mercury when introduced into the alimentary canal, and its high atomic weight and associated opacity to x-rays, suggests its use in the diagnosis of affections of the internal viscera, especially intestinal obstruction. The method recommended is to administer a certain quantity of the metal, and to observe its position in the organs by means of skiagraphy. Kronberg has been able to fill practically the whole intestine of small animals with mercury; in larger ones, and in the human cadaver, he can follow the course of the metal through the gut. In actual practice he considers that one to two hundred grains of mercury should be given in cases of intestinal obstruction from volvulus, intussusception, fecal masses, paralysis, etc. Bettelheim has shown that this alone is in many cases sufficient to effect a cure, and it is claimed that with the aid of Roentgen's method the seat of the obstruction can be diagnosed. Kronberg further points out that the use of mercury in this way may be very valuable in the diagnosis and localization of fistulous tracks and their ramifications in inaccessible parts of the body. In cases in which the use of mercury might be dangerous he suggests the substitution of the rare metal, gallium, which melts at 30° C., and has only half the atomic weight (and, therefore, opacity) of quicksilver.

In the pelvic cavity, as the ilium, like all other bones, is penetrable by the rays, foreign bodies, if sufficiently opaque, can be found with certainty by taking skiagraphs with the patient in various positions.

In dismissing the subject of foreign bodies I must allude to

the great satisfaction the Roentgen method has given me in dealing with the not uncommon class of patients who have imaginary foreign bodies and equally imaginary symptoms. Such persons, who formerly wandered from surgeon to surgeon until they found one willing to undertake an operation, and who then blamed him for not producing the suppositious cause of their troubles, can now be convinced and usually cured by a few minutes' exposure to the x-rays.

Fractures and Luxations.

Fractures of the skull are so often difficult of recognition without operation that any addition to our diagnostic resources in this direction is greatly to be desired. Especially is it to be hoped that we may be able by the skiagraph to recognize (*a*) fracture of the inner table, (*b*) linear fracture, (*c*) fracture of the base.

The first two should be possible, though I can find no record of the work being done clinically. It has been done for me experimentally with entire success.

The skiagraphing of fracture of the base bristles with technical difficulties, but they do not seem to me to be insuperable. Many skiagraphs of normal skulls in living persons must first be made and studied so that normal lines and shadows may be easily recognized.

Afterward the line of a fracture might perhaps be differentiated. Depressed fracture of the vault ought to be demonstrable in the majority of cases.

Fractures and dislocations of the spine. Here also the obscurity of many cases will almost certainly in the future be resolved by skiagraphy, with resulting benefit to both prognosis and treatment. If fractures without displacement could be recognized and distinguished from those more common ones in which dislocation has occurred and persists, and if in the latter the exact degree of luxation could be seen, and, therefore, the probable extent of the cord lesion estimated, we would have for the first time a satisfactory basis for deciding upon the method of treatment to be adopted in those distressing cases.

This work has been begun for me on the cadaver with moderate success, but the normal spine has been so often skiagraphed both antero-posteriorly and laterally that there seems to be no reason why we should not soon apply the method to patients who have sustained spinal injuries.

In fracture of the *sternum*, the *scapula*, the *clavicle*, and the *pelvic bones*, while I believe that no work of special importance has been reported, it is evident that the Roentgen method is competent to give us great help in obscure cases. In these instances, as in all cases where the shadow of one bone is necessarily superimposed upon that of another, the technical difficulties to be overcome in demonstrating abnormality are much increased. This remark also applies to all cases, either of fracture or dislocation, where it is impossible to get an entirely satisfactory view from both antero-posterior and lateral standpoints, as in lesions about the shoulder-joint or the hip-joint.

In such regions, for example, absence of the head of the bone from its normal position can be demonstrated easily; but it is more difficult to show the exact position occupied by the displaced bone.

The *ribs* present special difficulties on account of the movements of respiration, but the latter in doubtful cases can be much restricted by a fixed dressing not opaque to the rays, like sodium silicate, and a skiagraph should then show the fracture if there be one.

Fracture and luxation of *the bones of the extremities* (with the above-mentioned exceptions) can readily be demonstrated. In ordinary cases skiagraphy does not seem essential to the management of these fractures, but there are very many cases in which it assumes great practical importance. As examples I may mention:

(*a*) Fractures attended with so much swelling of surrounding tissues that satisfactory palpation of the fragments is impossible.

In such cases, although the setting of the fracture may really have been entirely accurate, the uncertainty often leads to another examination at an early date, and thus to unnecessary disturbance of the parts at a time when absolute quiet is im-

portant; or, to take the reverse of the picture, the professional attendant may have remained in ignorance of a faulty position of the fragments, which could be recognized only after the subsidence of swelling and too late for rectification, and which would result in permanent deformity or disability.

(*b*) Fractures about joints. The escape or the involvement of the joint in these cases is often a matter of doubt. The opinion arrived at influences both prognosis and treatment. Sometimes, especially in the smaller bones, as the phalanges, the decision as to the presence or absence of a fracture in the immediate neighborhood of a joint is exceedingly difficnlt to arrive at by ordinary methods, crepitus often being absent, and preternatural mobility being readily confused with the joint-motion.

(*c*) In epiphyseal separations, where also crepitus is often absent and the proximity to the joint confusing, the deformity slight, and the patient frequently so young that no information can be obtained as to the occurrence of traumatism or as to subjective symptoms.

(*d*) A few special fractures, chief among which is fracture of the femoral neck. If the presence or absence of this fracture in the many doubtful cases could be conclusively shown, and still better, if it could be demonstrated in a given case whether or not the fracture was exclusively intracapsular, most valuable information obviously affecting both prognosis and treatment would be acquired.

Mr. Rowland (*Brit. Med. Journ.*, December 5, 1896) has recorded a case in which he diagnosed a fracture of the neck of the femur in an adult of muscular build who was six feet in height. The negative would not admit of printing, but it was sufficiently distinct to furnish a tracing which was of great use in directing the treatment. Wullstein (*Berlin. klin. Woch.*, April 19, 1897) reports a similar case and another in which the differential diagnosis between fracture of the neck of the femur and luxation was made by a skiagraph. This fracture has been produced in the cadaver and an excellent skiagraph of it made for me.

Fractures of the os calcis and astragalus, both occasionally somewhat difficult of detection, have been shown clearly; I have had cases of each.

In certain special fractures the Roentgen method has been applied with very satisfactory results. The exact nature of the injury has been shown in a number of cases of fracture of the lower end of the radius by Conant (*Boston Med. and Surg. Journ.*, April 15, 1897).

Ununited fracture, even in the presence of close fibrous union, can be demonstrated with great accuracy, and if several views are taken the rays can usually be made to show the exact line and extent of the fracture. I have found this in several cases a great convenience as enabling me definitely to plan the operation in advance, and to decide upon the particular method to be employed for the purpose of fixation; silver wire, steel pins, or a plate and screws. Work has already been begun in the study of the repair of fractures, and it is now possible to determine the presence or absence of the lime-salts in the bond of union between the fragments. This we may venture to hope will in some cases prove of valuable assistance in determining the time of removal of the original dressing or the original splints, and, when necessary, the prolongation of the period of treatment in cases with a tendency to delayed union or to non-union as shown by continued translucency of the callus.

If the fixed dressing is made of one of the silicates, the further progress of the case may even be watched through it, and the need for more active measures, such as friction of the fragments on each other, may be thus determined.

If the ambulatory treatment of fractures of the lower extremities gains in favor, the ability to note the presence or absence of deformity, if some material not opaque to the rays can be used, will remove one of the greatest practical objections to the method.

I do not mean to assert that all this is possible at the present time, but I believe it will be a development of the near future.

In the disability following old fractures near joints and complicated luxations I have found skiagraphs of the region to be

of the greatest help in determining the mechanical cause of the limitation of motion and in deciding whether excision of the joint involved or some less radical procedure should be adopted.

Before leaving the subject of fractures it may be well to present for discussion a few questions having a medico-legal bearing, even although it may not be possible at present to answer them finally.

We may begin by asking whether skiagraphy has as yet given us a better understanding of fractures in general or has been the means of suggesting more efficient treatment.

It is difficult, in reply, to point to any one definite addition to our knowledge of these injuries, and so far as I know no material modification of the general rules governing the treatment either of fractures generally, or of any specific fracture, has as yet resulted; but in individual cases, such as have been described above, it has certainly been of great utility, and is likely to become more valuable as technique improves and experience increases.

The question whether or not the patient has the right to demand as ordinary care that the medical attendant should have a skiagraph of the fracture taken, I would at this time unhesitatingly answer in the negative. Until a much larger number of cases have been observed, and the pictures and the clinical results have been compared, the routine use of skiagraphy might be more harmful than useful.

Mr. Gerard Smith has called attention (*Brit. Med. Journ.*, November 14, 1896) to the necessity for eliminating the errors due to distortion of the image, owing to the want of parallelism of the objects, the rays and the plate or screen respectively. As he says, the most extraordinary apparent deformities of the bones in the shape of bendings, enlargements, and even of partial dislocation, can be produced both on the screen and the plate by varying the angles and position the rays make with the limbs and the receiving surface. Mr. Cottan (*Ibid.*, February 6) carefully examined skiagraphs published in the *British Medical Journal* purporting to show fractures of the styloid pro-

cess of each ulna in a case of double Colles fracture. He states that on comparing them with his own skiagraphs of the normal wrist and with those of an old standing Colles fracture, he found that in the *British Medical* pictures the styloid process of the ulna was in its normal position on each side and was unbroken.

Whether he or the previous reporter was correct is immaterial. The incident well illustrates the point I desire to make in reference to the undesirability, at least at present, of favoring the routine use of skiagraphy as an essential in the diagnosis and treatment of all fractures.

There can be no doubt, however, that skiagraphs will figure largely in suits for damages after accidents and in cases of alleged malpractice. They have already been admitted as evidence in such cases, and it is probable that juries will with increasing frequency have to decide whether to place greater weight on deformity as shown by skiagraphs or on expert evidence as to the absence of genuine disability. It seems obvious that each case must be studied by itself, but that it would be injudicious if not altogether unwarranted for us to assume at present that clinical experience and the judgment based upon it should be subordinated to the pictorial testimony of the skiagraph.

It is not, however, too soon to advise that in all obscure, complicated, and unusually difficult cases the help afforded by the Roentgen rays shall be secured by the surgeon, even if it is done chiefly with a view to his own protection.

As time goes on it is probable that we shall be better able to estimate accurately the precise clinical value of minor deformities. In the meantime it seems to me we should be careful to avoid the setting up of an impossible ideal as a standard in fracture cases.

Diseases of Bones and Joints.

It now appears to be beyond reasonable doubt that in the future we shall be able to make a definite diagnosis and to decide upon the form of treatment earlier than heretofore in a large variety of cases involving the bones and the articulations.

Rowland (*Brit. Med. Journ.*, October 3, 1896) has been able with facility to recognize caries of the cervical spine. Macintyre (*Ibid.*) has made excellent pictures of early tubercular disease of the hip in children. The former (*Ibid.*) has also shown the lesions of rheumatoid arthritis in the shoulder. Osteoma is, of course, easy of recognition. Intracranial exostosis and the ravages of osseous gummata in the same region should be demonstrable.

Göbel (*Deut. med. Woch.*, April 22, 1897) observed in a case of osteomalacia that had had multiple fractures of different bones that there were no shadows thrown by the bones, although they were perfectly distinct in other normal cases with the same tube. A comparison of the various bones of this patient with those of healthy individuals showed that they were much more translucent, the marrow cavity being transparent, while the wall of the bone was only visible at the margins of the bone shadows. This was accounted for by the decreased amount of bone salts. The study of rhachitis should give valuable and perfectly analogous results.

I have been able, in the long bones, to locate the site of the disease in cases of central abscess, caseous degeneration, and osteosarcoma. The pictures with or without the aid of clinical symptoms would in several such cases have been conclusive as to the exact position of the lesion. But the accurate differentiation of these diseases by the skiagraph has not yet been possible in my experience. In each case there is an absorption or diminution of lime salts producing a similar decrease of opacity over the affected area, whether the bone is the seat of a neoplasm, is the subject of cheesy or fatty metamorphosis, or is occupied by a collection of pus. It is probable that we shall learn later to distinguish between these conditions. At any rate, with but slight additions to the knowledge we now have, we shall be in a position to recommend operation earlier and to plan it more accurately than was formerly the case. In tubercular disease of the joints, for example, we may be able to determine and to remove the original focus of disease before the articulation becomes seriously affected; we may obtain

much help in making the choice between erasion and excision; we may determine in advance of operation in children whether or not the neighboring epiphyses are involved, and so decide between excision and amputation. Wullstein (*loc. cit.*) has demonstrated the different stages of coxitis in children.

In congenital luxations of the hip the condition of the acetabulum and of the femur has been shown and studied. In all varieties of talipes the precise relation of the bones to each other, the amount necessary to remove if osteotomy is required, the probable efficiency of orthopædic apparatus, can be worked out almost as if the dissected specimen were available. (Barwell, *The Lancet*, vol. ii. 1896, January 30, 1897.)

In Pott's disease not only can the carious vertebra be shown, but by aspiration of the resultant abscess and injection with iodoform-emulsion the cavity and ramifications of the abscess up to its vertebral origin can be clearly demonstrated. This has been done for me with entire success.

The changes produced by rheumatoid arthritis can be clearly seen, as I have already said, and it seems to me that it would be interesting to study by skigraphy the condition of such joints while undergoing the latest and in some respects the most promising method of treatment—that by superheated dry air. I have arranged to have this observation made.

In a case of arthritis deformans affecting the cervical spine the pathological changes were shown for me in detail; the tendons of the spinal muscles involved were the subject of calcification.

Periarthritis ought, in doubtful cases, to be more clearly distinguishable from true joint-disease. The mechanism of metatarsalgia has been shown and its diagnosis greatly facilitated by skiagraphy. (Morton, *Internat. Med. Mag.*, 1896, p. 329.) Floating bodies in the knee-joint have been seen, as in a case reported by Weir (*Medical Record*, April 3, 1897) and bodies connected with bursæ, as in the same case.

On the whole, it is evident that skiagraphy has added and is likely to continue to add to the definiteness and precision of our management of many forms of disease of bones and joints.

Returning to the *cavities of the body* (which I have only considered in relation to intruders from without), it would appear that in a number of conditions in which surgeons and physicians are almost equally interested the x-rays are likely to be of great service. I have already mentioned a case of gunshot-wound followed by traumatic pneumonia, and now under observation. If in that instance the pneumonia proves to be septic and suppuration ensues, as shown by the clinical symptoms, or possibly by the skiagraph itself, I shall be in a position to open and drain the lung abscess far sooner and more efficiently than if I were compelled to base my action solely on physical diagnosis. As Bouchard has been able clearly to recognize pleural effusions, patches of consolidation in the lungs, and pulmonary cavities (*Semaine Méd.*, December 9 and 23, 1896), it is conceivable that we may with advantage extend the field of operation in at least the latter class of cases. Grunmach (*Berlin. klin. Woch.*, June, 1896) has made a similar series of observations, as has Williams, of Boston (*Boston Med. & Surg. Journ.*, October 1, 1896).

The fluoroscope seems likely in these cases, as in various forms of cardiac disease, to be more useful than the skiagraph, as the latter in the case of organs in motion can only give the net result during the period of exposure. With fluoroscopic help, for example, we may be able in suspected pericardial effusions to employ paracentesis more frequently and more successfully. Mediastinal disease of various sorts should also be more easily discoverable in the early stages. Leonard has shown (*Univ. Med. Mag.*, 1896, p. 257) the possibility of recognizing and outlining intrathoracic aneurism.

The diagnosis between supra- and infra-diaphragmatic abscess, often extremely difficult, may be aided by a comparison of the density of shadow in the affected region with the normal standard. This is yet to be established and only by many observations and records.

In all this work, in fact, it must be understood that we are as yet merely on the threshold. I am talking of what seem to me to be possibilities, with the desire either of having their im-

practicability shown if it exists, or, on the other hand, of aiding in the development of the method along these lines. It should be remembered, however, in estimating the future of skiagraphy that by variations in the time of exposure, the length of focus, etc., it is possible to photograph certain portions of the trunk and omit others, to take the spine, for example, and omit the heart and sternum, or *vice versa*. The heart in action, the diaphragm in motion, the limits of the pleural cavities having all been seen, the extension of the method in the directions indicated seems on the whole likely soon to occur. (Macintyre, *The Lancet*, August 15, 22, 1896.)

Below the diaphragm the most interesting unsettled points relate to the value of the Roentgen rays in determining with certainty the presence or absence of various forms of calculi. As to *gallstones*, it has long been known that outside of the body they cast a distinct shadow which Mr. Morris (*The Lancet*, November 14, 1896) estimates at half the density of the shadow of the uric acid calculus. Gallstones have also been shown clearly when placed in the gall-bladder of a cadaver. In actual practice, however, in cases associated with jaundice with excess of bile in the gall-bladder, or with chronic inflammation and thickening of the surrounding tissues, they have not yet been well demonstrated. The opacity of the tissues around them, especially when impregnated with bile salts, is so similar to that of the calculi themselves that the latter do not show in the fully developed negative. In three cases in my practice they have been seen during the process of development of the plate, and were subsequently found and removed by operation, but no print showing their shadows was obtainable.

Experiment is constantly going on now to determine the amount of exposure necessary in different cases for the rays to penetrate the ordinary tissues without also penetrating the calculi. It will be seen that in gall-bladder cases this will vary with the thickness of the abdominal walls, the presence or absence of jaundice or its degree, the depth of the calculi from the surface, etc., and that much experience will be required before the diagnosis can be made with certainty. At present it is safe to say

that while in some cases the shadow cast by gallstones warrants a positive assertion of their presence, the absence of such shadow does not demonstrate their absence.

The above remarks apply without modification to *enteroliths*.

Renal calculi have been found in various cases, and successful operations have been based on the skiagraphic evidence. (Macintyre, *Brit. Med. Journ.*, July 25, 1896.) Swain has had a similar case. He has shown (*Bristol Medico-Chirurgical Journ.*, March, 1897), as have others, that oxalic calculi are almost impermeable to the rays, the shadow being correspondingly dense; phosphatic calculi come next, casting a fairly deep shadow, and then, though much fainter, come uric-acid calculi, not very far removed in penetrability from bile-stones. As uric acid is so frequently the predominating constituent of renal calculi, it is evident that the remarks as to time of exposure, the variation with the individual, etc., made in reference to the search for gallstones or for intestinal calculi, are applicable also to these cases. There can be little doubt, however, that we shall soon be able to diagnose renal calculi of every variety with almost unvarying accuracy.

Vesical calculi are more difficult, on account of the superposition of the bones of the pelvis. The cases in which the skiagraph would be of most value are those of pouched bladder or partially encysted calculus associated with enlarged prostate. Of course, if the enlargement prevents the introduction of a metal instrument into the bladder, the advantage of a skiagraph would be exceptionally great. Unfortunately the conditions which indicate the need for such a picture are also unfavorable to its production.

Experiment shows that stones can be clearly seen in an ordinary adult bladder. In a boy of eight the stone has been shown *in situ*. (Lawrie, *The Lancet*, January 16, 1897.)

Foreign bodies, such as hairpins, have been seen and removed. (Leiffert, *Centralblatt für Gynäkologie*, No. 1, 1897.) If, as seems probable, we can apply the method to the above-mentioned class of cases, and to the exploration of the bladder after

litholapaxy, we shall owe to it another marked addition to our surgical resources.

Ureteral stone has not yet been seen clinically, but seems likely to be easy of recognition.

I am having made at present a series of observations on the opacity of various materials used in surgery as antiseptics and for dressings, or in the form of lotions or local applications. It seems desirable that we should know what materials should be selected in cases in which it is possible that skiagraphy may be required without disturbance of dressings. The result, with which I need not now detain you, will be published later.

The apparent toxic effect of the rays upon the skin of operators and subjects, producing dermatitis, alopecia, loss of the nails, and even according to Gilchist (*Johns Hopkins Hospital Bulletin*, March, 1897) an osteoplastic periostitis and osteitis (as shown by the skiagraph and by the clinical symptoms), has been widely discussed of late. Several dozen cases have been reported. It seems probable at this time that it is not merely an effect of close contact with the electric current employed, and is not due to any of the chemicals used, but it is a specific effect of the rays themselves, some persons being more susceptible than others. Dr. Thorne has asserted that in two instances, after a prolonged examination of the heart, that organ has demonstrably diminished in size, in one case by as much as two inches. The observation remains unconfirmed, and is contradicted by Dr. Thomson. (*Brit. Med. Journ*, October 24, November 7, 1896.)

The possible therapeutic properties of the rays has from the first engaged the attention of some members of our profession. They were thought to be germicidal, and a positive announcement to this effect was made, but was soon with equal positiveness denied. Quite recently (*Semaine Méd.*, January 20, 1897) Rendu has revived the matter by reporting the case of a man aged twenty years, who had an illness, beginning with characteristic typhoid symptoms and followed by typical infective pneumonia. Pure cultures of staphylococcus were found in the sputum. After an incomplete defervescence the fever returned, and all the signs of suppuration of the pleura or lung developed.

Examination of the sputum, which could only be obtained twice, showed a few tubercle bacilli, but the respective parts played by the staphylococcus and the bacillus could not be determined. Whatever the exact nature of the disease, the patient at the end of six weeks' illness, with hectic temperature, appeared to be dying. He was then exposed to the Roentgen rays for fifty-five minutes every day. After the fourth exposure the temperature fell by crisis, and never rose again. This was accompanied by diuresis and diaphoresis, and the patient was soon quite well. This may have been a coincidence, but no other change in the treatment or conditions was made. After ten applications erythema and ulceration of the skin appeared, and it is possible that equally marked trophic changes took place in the deeper tissues also. In the discussion which followed the paper, Du Castel thought the success of the treatment pointed to the staphylococcus being the cause of the illness, since all the attempts to prevent the development of tuberculosis by the same means had hitherto failed.

I must confess that, as with every new discovery, my thoughts turn to its possible application to a subject which has an invincible attraction to me—the cure of cancer. I was therefore led, in a purely speculative and empirical manner to direct the use of the x-rays in a number of inoperable cases of cancer in various regions. My small hopes of success were bolstered up somewhat by reflections upon the hypothetical bacterial cause of cancer, upon the wonderful effect of sunlight on the tubercle bacillus, upon the remembrance that the most powerful germicidal effects of the sun are caused by the rays near the violet end of the spectrum, and having the most chemical activity, and that Roentgen's rays are ultra violet, and possess chemical activity (Lyon, *Brit. Med. Journ.*, February, 1896), (Bowles, *Ibid.*, March 1, 1896), and finally upon the early vague reports of trophic changes produced by the x-rays.

I have no results to report. Indeed, as yet, I have no results at all, but I was surprised to find that what last fall seemed to me an entirely original thought had occurred to V. Despeignes, who in July and August, 1896, had reported in the

Lyon Médical a case of gastric carcinoma which had appeared to be greatly benefited by the transmission of the rays through the seat of disease. More recently the same gentleman states (*Lyon Méd.*, December 28, 1896; *Brit. Med Journ.*, February 20, 1897) that after the report of his case appeared he received a communication from L. Voight, Director of the Vaccine Institute of Hamburg, giving an account of the following case: The patient was a man, aged eighty-three years, who had complained for nine months of difficulty in swallowing and pain in the left ear and in the occipital and cervical distributions of the left facial nerve. There was a small epithelial cancroid ulcer in the mouth, starting from the lingual fold, with an enlarged gland in the submaxillary region. Salivation was continual and pain so severe as to require regular administration of morphine. On August 28th the application of Roentgen rays was begun with an apparatus yielding sparks of 10 cm. used in two daily sittings of one-half and sometimes a quarter of an hour; the pain almost immediately diminished so much that the morphine was discontinued, except an occasional dose at night to induce sleep. The patient was beginning to hope for a cure, but the disease invaded the left part of the tongue, salivation did not cease, and the difficulty in swallowing increased. The patient became emaciated and died on October 22d of pneumonia, after one hundred applications of the rays, which gave him considerable relief.

The good effect of the rays was not attributed to suggestion, because it lasted eight weeks, nor to destruction of sensory nerves, since, as a matter of fact, these were not destroyed. The growth did not, as in Despeignes's case, diminish in volume. Voight thinks that it may, however, be taken as proved that if the rays have little or no action on the evolution of the disease their anæsthetic effect is very marked. It may be added that after the eightieth sitting the skin of the left cervical region became almost as black as that of a negro; a similar pigmentation took place on the right side when the rays were directed upon that side.

I intend to continue my own experiments until I am convinced that they are useless.

In the meantime the increasing evidence as to the trophic changes apparently produced by the rays have led me to resolve, in addition, to extend their attempted therapeutic use to those cases of extensive capillary nævus which sometimes make such hideous deformities, to similar cases of hairy moles, to inoperable cases of keloid and hypertrophied cicatrix, and to analogous cases not adapted to removal by the knife or amenable to other well-established surgical procedures.

I feel reasonably sure, as in the cancer cases, of doing my patients no harm even if the experiment is an entire failure.

The technical work which was the basis of this paper was done for me by Dr. C. L. Leonard.

DISCUSSION.

Dr. W. W. Keen, of Philadelphia.

The paper has covered the whole subject so completely that there is very little left to be said, and for this reason, together with the lateness of the hour, I will refer to but one point which Dr. White has already noticed—*i. e.*, the medico-legal relation of the x-rays. In this connection I want to call attention to one case which I think has an important bearing in reference to the occasional unreliability of the x-rays. We know so little of the normal anatomy of a fracture that we should not lay too much stress upon pictorial evidence. The case was one of bowlegs at the Orthopædic Hospital—a young child. Dr. W. J. Taylor operated. The tibia was partly chiselled through and then fractured, followed by fracture of the fibula. A skiagraph was taken the next day, but showed no recognizable fracture. Here is a case in which we knew there was a fracture, as it had been produced purposely. I simply call attention to this case as showing that we must be careful as to our conclusions even from skiagraphs.

Dr. C. B. Nancrede, of Ann Arbor, Mich.

It will be impossible adequately to discuss this excellent paper of Dr. White's, and I shall confine my remarks chiefly to a few practical points with reference to the detection of foreign bodies. When considering any new aid to diagnosis certain questions press for a solution. Can the new method be employed by the inexperienced, or must accuracy be acquired by prolonged practice, while the lack of this will lead only to error? Does the method necessarily entail expensive apparatus and the consumption of much time in using it? Wherein is the new method superior to those already at our disposal for the detection of foreign bodies? What, if any, precautions must be adopted to insure success? Does the patient run any risk, if so how can this be prevented or at least minimized? My object to-day will be to show by the skiagraphs exhibited and the comments, that the comparatively inexpert and those unwilling to expend much money can secure all the essential advantages of the Roentgen-rays. Although experience unquestionably increases accuracy of observation and interpretation, the adoption of a few simple precautions will obviate nearly all serious error.

Expensive apparatus, giving as it does quicker and easier results, is desirable, but it is not essential. The static apparatus supplied by Frie & Co., of Boston, at a cost of $70.00 will, as you see, give admirable results. The advantage over all previous methods for detecting foreign bodies is the greater certainty secured. Where the tactile sense fails or local symptoms are only misleading, by the x-ray certainty is in nearly all cases attainable. If a proper skiagraph or series of skiagraphs taken from various points fails to reveal a foreign body, its absence can safely be affirmed, which fact is often of equal importance with the demonstration of the presence of such a body.

To avoid being misled as to the exact locality, say of a needle, skiagraphs should be taken from different points of view, preferably at right angles to one another. If this be impossible, reasonable certainty can be secured by placing a test-object on the plate, and comparing its definition with that of the object detected, when the relative position of plate and light is reversed — *i. e.*, the one showing both test-object and foreign body more nearly with the same definition, the nearer is the object sought to the surface where that plate was placed.

When a skiagraph is taken from only one direction, as Codman shows, the following possible errors must be allowed for, viz., the magnification—hence distortion—of the parts most distant from the plate, and "the elongation of shadows of those parts of the object" —or foreign body itself—"which are distant from the base of a perpendicular from the point of light to the plate. This elongation increases with the increase of the distance of the part from the base of this perpendicular, and takes place in the direction of the part from the base of the perpendicular." The portion to be studied should be as near the plate as possible.

The sharpness of definition of imbedded foreign substances varies greatly. Iron and lead come first, copper and brass, as pins, next, and glass last of all; the latter, if in small fragments, can probably be often only detected by a *good* skiagraph and not by the fluoroscope.

So-called burns can be avoided by short exposures not exceeding fifteen minutes, by employing less powerful currents, by low or medium tension tubes, and by protecting the parts with a layer of vaseline. Static electricity has as yet not been accused of producing these burns. Unfortunately no satisfactory skiagraphs can be secured by the static machine of the adult chest, head, abdomen, or hip without very prolonged and therefore tedious exposures; but for the

detection of foreign bodies located in the ordinary situations the static machine is entirely satisfactory.

In all doubtful or important cases a skiagraph is to be preferred to the fluoroscope. If this instrument unquestionably indicates the presence of a foreign body which can be discerned from different points so that it can certainly be located, nothing further may be requisite. If, however, nothing is detected, one or more skiagraphs may yet demonstrate the presence of a foreign body. A little practice is also requisite to get the best results with the fluoroscope; the observer must learn to recognize the significance of what he sees, somewhat as one does when learning to use the microscope. Sometimes throwing the part out of focus, as it were, by alternately withdrawing the fluoroscope from and then approximating it to the object, by blurring of the outlines of a foreign body will so increase its apparent size that the eye can recognize it; then, once detected, it can be found again and defined by a better relative position of the light and instrument.

No skill as a photographer is absolutely requisite, because with the specially prepared plates or bromide papers now on the market, after exposure these may be sent to a distance when no professional photographer is at hand. I have purposely avoided all attempts to indicate *how* to take skiagraphs as out of place in this part of the discussion. In conclusion, I must thank my colleagues, Profs. Carhart and Herdman and Mr. R. D. Wilson, medical student, for much of the practical work exhibited.

Dr. G. R. Fowler, of Brooklyn.

I have employed the battery, street current, and static machine, and think there is very little to choose between them. There are some opportunities for error which should be borne in mind; I have seen this in a case of dislocation of the ulna and radius. A picture taken from the lateral aspect absolutely failed to reveal the condition, while one taken antero-posteriorly showed it very satisfactorily. In another instance, where there was marked deformity after a Pott's fracture, the question arose as to whether there was sufficient distortion of the osseous structures to warrant operative interference. Under these circumstances a picture taken laterally failed to give any definite information, while that taken from behind showed that the osseous deformity was slight compared with that of the soft parts. Under an anæsthetic the breaking up of the adhesions overcame the existing

splay-foot, the patient being thoroughly cured by this comparatively slight operation.

With regard to the detection and removal of foreign bodies, an ingenious machine has been devised and carried out for the removal of a foreign body from the œsophagus by Dr. H. B. Delatour, my late assistant at the Methodist Episcopal Hospital in Brooklyn. A pair of forceps are guided down the gullet by the aid of a fluoroscope. The instrument makes a shadow upon the screen, and when the shadow comes within a short distance of the foreign body the jaws of the forceps are opened and the foreign body grasped. This suggests the possibility of locating and removing in a similar manner missiles from gunshot-wounds. In the case of a patient injured by a 40-calibre bullet, the skiagraph of which is herewith presented through the courtesy of Dr. Gaston, all attempts to remove it were without avail, although it was apparently definitely located by the skiagraph, and was surely known to be present. If the fluoroscope is employed in conjunction with the telephone probe, one might, in a similar case, be able to determine the location of the bullet without performing an extensive cutting operation.

Another source of error is the possibility of defects, either upon the negative plate or upon the paper used to make the print. In one of my cases in which it was thought that an accurate picture had been taken, this bearing out a previously conceived mental picture of the conditions present, the possibility of error arising from one of these sources occurred to me. Two more prints revealed the fact that the supposed diseased condition did exist, the appearances presented being due to a defect in the printing paper.

With regard to malpractice suits: a lady recently came to me with a skiagraph of a part of her forearm, wrist, and hand, showing apparently a most deplorable deformity as the result of a Colles fracture. The picture had been taken for her at one of the x ray studios conducted by a lay combination of electrician and photographer. She considered the case one of gross malpractice, and threatened suit against the practitioner who had treated it. In reality the deformity was nothing like as great as the picture showed. I found that I could put her well arm in such a position with relation to the plate as to produce a greater deformity than that which it was claimed existed in the injured arm. I also was able to place the hand that was deformed in such a position that the bones appeared almost normal in the picture. These x-ray suits are likely to become sources of annoyance

and even financial loss to surgeons. Personal damage lawyers will enter into collusion with those in charge of the x-ray studios, and patients who from curiosity or other motives apply for skiagraphs of fractures will be encouraged to institute legal proceedings to recover damages for alleged improper treatment.

DR. M. H. RICHARDSON, of Boston.

One of the most important points in reference to skiagraphy is its relation to the diagnosis of fractures. There is no doubt that many suits for malpractice will result, and the question is as to the responsibility of the surgeon in such cases. Is it incumbent upon a surgeon to resort to the x-rays in diagnosing these cases? This is especially true with fractures of the lower extremities, although almost equally so in cases of fractures about the wrists. There is no reason why we should not use the x-rays in every case of injury to the shoulder or elbow. I have some very poor skiagraphs of fractures or suspected fractures which I wish to show. One and two are the right and left ankles of a young lady who was thrown from her carriage, and the skiagraphs were taken through a plaster-of-Paris bandage. They can be so taken as to be apparently of the same foot. You can see that there is no dislocation of the astragalus. Here is a poor skiagraph of a medico-legal case, and shows a separation of the fragments of the patella. The next one shows the same condition six months afterward. Removal of the middle fragment was performed, and the next one shows the position of the fragment in the patella. I have operated on two cases upon the strength of the skiagraphs. One was a case of stiff elbow in which the articular surface of the external condyle was raised. I cut down upon it and chiselled away. I have talked the medico-legal side of this question over with several of our judges, and some of them are going to admit these skiagraphs. The important point is how you can tell the skiagraphs are accurate, and this is a very difficult matter. In many cases it will be absolutely impossible for us to say there is no fracture. I could not detect any in one case, but there was one. We could not bring up a more important subject at this time, and the question is as to the position the surgeon should assume when he meets with fractures and dislocations. A great deal of trouble is going to result from these pictures. If it is true that they are not accurate, and that fractures are shown when none exist, then they cannot be relied upon in diagnosis. With regard to the detection of a drainage-tube, I did not bring a skiagraph with me

which shows this, but it showed a foreign body at the end of which was a safety pin. It turned out to be a drainage-tube which had not been removed after operation.

Dr. F. H. Williams, of Boston (by invitation).

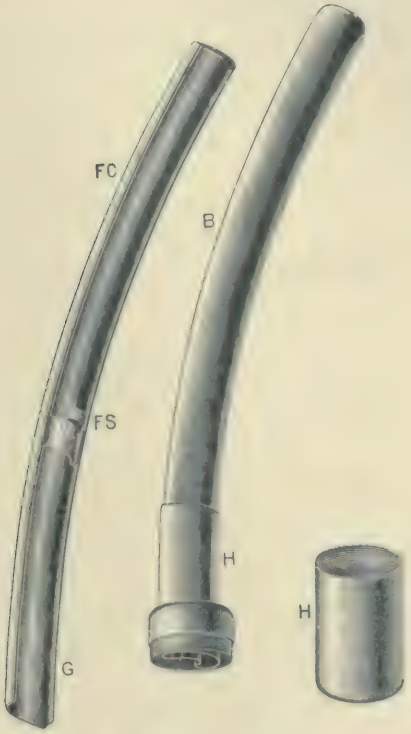
I am glad to have had the privilege of listening to Dr. White's excellent presentation of the subject and to take part in the discussion. During the past year I have made more than five hundred x-ray examinations at the Boston City Hospital and at my office. About four hundred of these were cases that came to the physician rather than the surgeon, and were chiefly those with some disease of the chest, the remaining one hundred were surgical cases; some of the latter class were patients with bullets or foreign bodies, for the locating of which I have devised a method that has worked satisfactorily. While examining the patient through the fluoroscope I marked with a pencil, especially arranged for this purpose, with a strip of lead down one side, the point on the skin under which the bullet seemed to be, both on the side next the fluoroscope and on the side next the Crookes tube, and at these points drew the figures 1 and 1′. I then turned the patient, or the special part, about 90°, repeated my examination with the fluoroscope, and marked the point on the skin under which the bullet seemed to be, both on the side next the Crookes tube and on the side next the fluoroscope, 2 and 2′. The bullet is found at the point where a line running from 1 to 1′ crossed a line from 2 to 2′.

In making x-ray examinations it is well to place the healthy and diseased parts side by side under a large fluoroscope when possible for purposes of comparison, as by this means some things may be revealed that would otherwise escape observation. For example, a comparison of this kind between a tuberculous and a healthy knee shows that in the former the outlines are less sharply defined than in the latter, and that more light penetrates the diseased than the healthy bones, although the tissues surrounding the former are not so light as normal. This is due to a change in chemical composition, and other chemical changes may likewise be detected. For instance, in some forms of cancer the diseased parts are less readily penetrated than the healthy tissue.

In radiographs which I have taken of healthy individuals, one sees in some cases the fatty tissue, muscles, tendons, and arteries. This is largely due to variations in chemical composition. The importance to us of this knowledge of chemical composition in our use of the

x-rays is further illustrated in a striking manner by an experiment I made with calculi. Before attempting to detect them in the body I made a radiograph of several different kinds that were sent to me by Dr. William F. Whitney from the Harvard Medical School. The rays penetrated the calculi made up of uric acid, of cholesterine and biliary salts very readily, but were obstructed by calculi containing oxalate of calcium in considerable proportion, phosphate of calcium, or other inorganic constituents. Further study showed that organic substances are quite as readily penetrated by the x-rays as the soft tissues of the body, and therefore it is obvious that any attempt to detect in the body calculi made up of organic compounds would, so far as our present knowledge goes, be difficult, whereas those of inorganic origin might be detected. If diagnosis by some other means than the x-rays shows that there is a calculus in the bladder, for instance, which cannot be demonstrated by a good radiograph taken with an instrument I shall describe presently, we know it is made up of uric acid or some substance composed chiefly of organic constituents. Dr. William H. Rollins, of Boston, has invented the instrument just referred to for radiographing calculi of inorganic origin in the bladder. I have used this in two cases and found nothing in the films—the calculi were subsequently removed and proved on analysis to be made up of an organic substance, in that case it was uric acid. The illustration shows the various parts of the instrument, which consists of an aluminum tube 9 inches long and 1 inch wide, a cross section of which bears some resemblance to a crescent. The tube is closed with a solid piece of metal at one end, and to the other is fitted a handle which screws on (see H and H). FC is a thin piece of metal with grooved edges, which holds several pieces of photographic film or pieces of bromide paper which should be about as wide as the tube and about half as long. To put the films in place the sliding piece FS is removed from FC, the films are slid into the grooves and pushed to the end as far as they can go, after which the piece FS is put back to hold the films in place. The whole is then pushed inside of HB, and the round handle H screwed on; this must be done in a dark room. The instrument carrying the films, with the convex side up, is then inserted into the rectum of the patient, who is placed on his back, and the instrument is held in such a position that the films are brought just below the bladder. The rays from the Crookes tube, which is placed over the bladder and some distance from the abdominal wall, penetrate the tissues and the aluminum wall

of the tube and act upon the film. After an exposure of a few minutes the instrument is withdrawn, and the films are taken out in a dark room and developed like any other photographic plate.



The further development of the use of x-rays in medicine, after the apparatus is perfected, will depend upon a careful study of the chemical composition of the body in health and disease, but I have already taken up elsewhere (*Medical and Surgical Reports of the Boston City Hospital*, January, 1897) the relation which chemical composition bears to the readiness with which substances are penetrated by the x-rays, so will not pursue this subject further now.

Dr. Christian Fenger, of Chicago.

There is an individual in the Rush Hospital in Chicago on whom the x-rays were used in searching for a bullet in the cranium. A few weeks afterward an inflammation set up, and all the soft parts of the

scalp down to the bone died. This was supposed to be due to too long exposure.

DR. J. R. WEIST, of Richmond, Ind.

Would it not be a good idea to appoint a committee to formulate an opinion as to whether or not these skiagraphs are reliable. I understood Dr. Nancrede to say that anybody could make these pictures, but I do not think that everybody can do so satisfactorily. Those who are familiar with the processes of photography know that the degree of development and the length of the exposure are all important factors. No surgeon can determine positively the actual value of the pictures produced unless he is familiar with all the factors which enter into their production.

DR. P. S. CONNER, of Cincinnati.

In referring to Dr. Weist's suggestion to appoint a committee to inquire into the reliability of the skiagraphs, I think such a committee should consider the local and general results of these rays, to the end that if possible something definite might be ascertained respecting the method of production of their occasional ill effects, as also the real value of the skiagraphs as aids to a diagnosis. The committee should be composed of men who are familiar with the subject, and should, if possible, make a full report at the next annual meeting, remembering that this Association represents, in no small degree, the surgeons of the country, and its expressed opinion, therefore, will carry with it much weight.

DR. NANCREDE, referring to Dr. Weist's criticism of his (Dr. Nancrede's) remark that anybody could take these pictures, said that he thought he made himself plain that the operator need not be a skilled photographer, because, if necessary, the plate could be sent a thousand miles to an expert for development and decision. This is possible, because special plates are made so protected that after exposure their safe carriage to a distance before development is perfectly feasible.

DR. DE FOREST WILLARD showed a number of excellent skiagraphs of fractures, dislocations, tuberculosis of joints, ankylosis of joints, etc. One of the representations of dislocation of the head of the radius was taken through a heavy plaster-of-Paris cast, demonstrating the fact that the rays will penetrate this substance. Another radiograph showed exostoses, another cure from fracture of the patella, etc.

TENO-PLASTIC SURGERY.

By E. H. BRADFORD, M.D.,
BOSTON.

THE surgery of the tendons could until recently be briefly described as tenotomy and the suture of traumatically divided tendons. But the field has been enlarged since suturing the distal cut end of the tendon of a paralyzed muscle to the proximal end of the tendon of a strong one has been successfully performed.

This procedure is not in as general surgical use as is desirable, largely because sufficient attention has not been called to the subject.

The first to suggest tendon transplantation was Nicaladoni, who, in 1881, reported the transplantation of the peroneal tendon to the tendo-Achillis in a talipes calcaneus. Hacker has reported a similar case. Phocas and Parrish report cases. Goldthwait, in 1895, and Milliken, the same year, have reported successful cases, the former having shown by a series of unusual successes the value of the method. Nicaladoni and Willet some years ago shortened, in cases of calcaneus, the lengthened tendo-Achillis, and later, both Goldthwait and Milliken have reported cases where the sartorius muscle is inserted into the tendon of a paralyzed rectus.

This constitutes a short statement of the brief medical literature in a branch of surgery which offers, in the success already attained, a field of great interest and surgical satisfaction. The technique which is required involves a good knowledge of the anatomy of the parts and of the functions of the various muscles. It also involves a careful examination of a paralyzed

limb in order to determine what muscles need strengthening and what are useful. A certain amount of delicacy of manipulation is needed for success, and also some skill in the insertion and quilting of the transplanted tendons into structures which will in future bear considerable strain. Transplantation of tendons has up to the present time been confined to the lower extremity in cases of paralysis from anterior poliomyelitis.

A detailed description of the well-known condition of the limbs following infantile paralysis is unnecessary. It will suffice to mention that in most instances all the muscles of the limbs are not paralyzed, that certain muscular groups may be spared, but for want of antagonists pull the foot or leg into a useless and distorted position. It is necessary not only to correct the deformity, but to restore the balance of the muscles to prevent a recurrence of the deformity. The following may be mentioned: transplantation of the peroneus longus into the tendo-Achillis, into the tibialis posticus, and into the anticus; the union of the tibialis anticus with the extensor longus digitorum; shortening of the extensor tendons of the toes; shortening of the tendo-Achillis; lengthening of the tendo-Achillis, and insertion of the sartorius muscles into the rectus femoris tendon.

Transplantation of the Peroneus Longus.

Where a tibial group of muscles is weakened and the foot pulled to the outer side, the peroneal tendons being strong, it is desirable to transfer the connection of the tendons in such a way that they will in part take the place of the weakened tibials. The tendon which lends itself to this procedure is the peroneus longus. An incision is made between the outer malleolus and the tendo-Achillis, somewhat in the line for the ligature of the peroneal artery, but slightly anterior to it. The sheath is opened, slightly above the level of the malleolus, and the tendon gently pulled from the sheath and divided across. The cut end is pulled from the sheath, and enough of the tendon freed to leave a lower tendinous end of at least two and a half inches in a foot of moderate size. The incised wound is

then held apart by means of a retractor, and an opening made between the tendo-Achillis and between it and the tibia, the lower tissue in this region being partly incised, and the opening gradually dilated until the tendon can be passed through. An incision is then made on the inner side of the foot in the region of the posterior tibial tendon, the line of incision being slightly in front of that for the ligature of the posterior tibial artery. The paralyzed posterior tibial tendon is then divided across close to its insertion; the cut peroneal tendon is passed through the opening beneath the tendo-Achillis, and the cut surfaces of the peroneal and posterior tibial tendons are firmly sewn together. The skin wounds are then sewn.

Where the gastrocnemius is the paralyzed muscle which needs reinforcement, the cut peroneal tendon is passed through a slit cut in the widest part of the tendo-Achillis. The inserted tendon should be stitched with interrupted sutures as it enters the tendo-Achillis and as it emerges from the other side; the projecting end can be folded along the edge and stitched to give greater strength.

The Suture of the Anterior Tibial to the Extensor Proprius.

A straight incision is made in the direction of the extensor proprius pollicis, which can be easily determined by forcibly flexing the great toe. The incision is slightly to the inner side of this tendon; the sheath of the tendon is discovered and opened; the tendon is drawn from its sheath but not cut across. The tibial tendon will be found lying slightly to the inner side of this; no separate incision is necessary. If the muscle is completely paralyzed, the tendon can be cut across and be sewn into the adjacent tendon of the flexor longus pollicis. If the tendon is not completely paralyzed, but needs reinforcement, the side edges of both the tendons can be refreshed, and the contiguous portions sewn together. It is desirable to avoid opening the annular ligament of the ankle, and this is not necessary. It is, however, important that a sufficient amount of play should be given to the tendon.

Transplantation of the Posterior Tibial Tendon.

I am not aware that this transplantation has ever been done. It would, however, seem to be a feasible operation, and the steps of the operation would be similar to those already mentioned for the transplantation of the peroneal tendon. The method would recommend itself in cases of paralysis of the peronei, and in paralytic club-foot, where the tibials should be weakened with the hope of strengthening the peronei. A transference of the anterior tibial across the front of the foot to the insertion, to reinforce the peronei, has also, as far as I know, not been done, and seems hardly to recommend itself, as it would be necessary for the tendon to pass under the extensor tendons of the toes which are not separated from the bone by loose areolar tissue. It may, however, be advisable to unite the peroneus longus, if paralyzed, to the extensor tendon of the fourth or fifth toe, if the latter remains strong.

Goldthwait recommends in certain cases of anterior paralysis, where the tendons are so small that it is difficult to suture them and furnish a firm union, muscle transplantation uniting the bellies and the intramuscular fascia of the anterior tibialis with that of the common extensor and peroneous tertius muscles, expecting that, after union has taken place, the action of the strong muscle will pull upon the weakened tendon, and later performing a tenotomy upon any tendon the use of which can be spared. The method has been employed in a few instances by him with success.

Shortening of the Tendons of the Flexor Communis Digitorum.

This operation I have attempted once, in a case where the foot dropped from the entire paralysis of the anterior muscles. The tendons can be divided and shortened above the annular ligament or below it. The former is preferable, as the scar on the dorsum of the foot below the ligament would be inconvenient for shoes, and would hardly give sufficient room for the shortening of all the tendons which spread along the foot.

Shortening of the Tendo-Achillis.

An incision is made along the tendon, either directly over the tendon or slightly to the side. The latter seems to me to be preferable, as it avoids a scar over the most prominent portion of the tendon. The tendon is laid bare, and the tendon which is relaxed is pulled from its sheath and divided obliquely from above downward; the projecting cut ends are pulled respectively upward and downward, and the tendon sutured by a side-to-side suture, placing such at a lower and higher level than its former position.

Lengthening the Tendo-Achillis.

This is ordinarily done by means of subcutaneous tenotomy. In some instances, however, where a foot is especially weak from infantile paralysis, and the amount of lengthening to be desired great, the danger of non-union is sufficient to warrant open incision and the lengthening of the tendo-Achillis. This can be done by the same incision and a similar method as shortening the tendon, with the exception that the obliquely cut tendon is pulled apart, and the free ends united at a lower and higher level than before, in a manner reverse to that done for shortening the tendon.

Great care of the sheath is necessary, which should be sutured separately to secure free play of the tendon within it.

The method of suturing the tendon is of importance. Tendinous structures may be supposed not to unite as readily as other tissues, as their vascularity is less, and furthermore, the strain to which they are subjected is great. It is essential, therefore, not only that no sloughing should take place, but that the sutures should be such as will keep the parts in close contact, and also not compress unduly. It is of great importance also that the sheaths of the tendon should be but little enlarged, and that the opening through the sheaths of the non-paralyzed muscles should be carefully made, and the tendon handled with care and delicacy. Either catgut, fine silk, or kangaroo tendon can be used for suture.

It is important that the tendons be applied in such a way that the power in contraction is not lost or impaired. It is manifestly useless to expect any power if the tendon is placed nearly at a right angle to its original direction without a firm bone to pass around. The peroneus normally plays around the malleolus; but if it is divided and inserted into the posterior tibial, it cannot be expected that it will exert sufficient power if it passes in loose tissues at a sharp angle with its former direction. Neither can it be expected that the tendon can exercise much power if it is slack in its new position. Although a certain degree of adaptability of the tissues may be expected, there is a limit to this.

Judgment is also required in the length of the tendon to be left after the suture. No precise rules can be laid down in this matter, success depending upon the judgment and operative sense of the surgeon. Where errors of judgment take place, failures or imperfect results will follow. After the operation protection is necessary for awhile, by a support which prevents strain upon the affected tendon. Where the muscle is not completely paralyzed but some power remains, a better result can be expected if the muscle is exercised, and in many instances it will be found that a muscle which is apparently unable to exert any great power may develop some strength by use. After-treatment following these operations is, therefore, one which requires considerable care. Supports should be used which will constrict as little as possible. The foot or limb should be placed in such a position as to relieve the muscles and tendons operated upon from any strain. Besides the ordinary aseptic dressings, the limb should be covered with sterilized sheet wadding, and the foot and limb held in a plaster-of-Paris bandage, which should remain until union is expected, after which the plaster bandage may be followed by a removal appliance, the patient walking with crutches until the parts are sufficienily strong to stand the amount of weight necessary in locomotion. Later it becomes a question of judgment whether the limb should be supported by means of an apparatus, or whether crutches or a cane alone should be used. Where a large tendon is shortened, as the

tendo-Achillis, it will be necessary that an apparatus should be worn for several months, according to the age and size of the patient operated upon. The form of apparatus varies with the case, and resembles the appliances which are used for infantile paralysis. It should, however, be borne in mind that no apparatus should be used with straps exercising pressure directly upon the tendons which have been operated upon.

In judging of the ultimate success of this operation, it can be said that the immediate result is always successful as far as recovery from the operation is concerned, this being unattended with danger and always followed by healing. Where ordinary judgment is used, and healthy tendons are sewn to paralyzed ones in a proper manner, there is always a recovery of motion as soon as the wound is healed in the paralyzed tendons attached to an active muscle. This recovery may be regarded as permanent. The actual benefit, however, to be gained as an ultimate result, will depend upon the strength of the muscle utilized, as well as the part operated upon. Where the patient is heavy and the tendon subjected to great strain, as a tendo-Achillis reinforced by a peroneus muscle, the benefit obtained is not as great if the peroneus is a feeble as if it is a strong muscle.

Transplantation of the Sartorius Muscles.

This is a procedure which has been successfully performed by Goldthwait, and also by Milliken. An incision is made along the region on the inner side of the thigh, from the internal condyle upward in the direction of the insertion of the long adductor tendon. The limb is flexed at the knee and abducted. Some difficulty is frequently encountered in finding the sartorius muscle, which in a paralyzed limb falls more toward the popliteal side than is normally the case. The muscle will be recognized by the nature of its fibres, as well as the direction in which they run. The muscle should be followed down well toward its insertion, and cut across at the level of the internal condyle, or slightly below it. The skin incision is then drawn to the outer side, and the conjoined fascia of the rectus and vastus internus is found. The fascia covering this and forming

a portion of the tendon is to be dissected up. The divided sartorius muscle is inserted underneath the fascia and sewn to it for the length of half an inch to an inch. Sutures are placed not only on the end, but on the side of the cut muscle, the fascia which is dissected up to cover the muscle being sewn carefully down on the side to the adjacent portions of the tendinous fascia as well as to the muscle. Beyond the difficulty of finding the sartorius muscle, the operation is a simple one, and this difficulty can easily be avoided if it is borne in mind that the position of the sartorius is not that in a normal limb. After the operation the limb is to be fixed in a straight position.

Spastic Paralysis.

Lengthening of the tendons and intra muscular fascia in cases of Little's disease, or infantile spastic hemiplegia, is but little known and of comparatively recent introduction, though the benefit of this operation is beyond question, and has the sanction of the usage of several years. It was first recommended by Rupprecht, and has since been employed with success by several surgeons. It is of advantage in such cases of this affection of the lower extremity as may be seen in children who are not mentally deficient; slight benefit is obtained in children with marked mental deficiency. This procedure will be found of value in spasm of the gastrocnemius muscle, in the flexor muscles of the legs, and in the adductors. It has also been of use in the spastic condition of muscles of the arm and hand in spastic paralysis. The object of the procedure is to remove the obstacle to the use of the limb in cases of this sort, which lies in the inability of the opposing muscles to counteract the constant spasm of muscles contracted from an exaggerated reflex sensibility. In some of these muscles a shortening has already taken place which no amount of manipulation, or massage, or mechanical stretching satisfactorily overcomes, but which can be removed by tenotomy. It is, of course, of little use in older cases where too great structural change has taken place. It will, however, be found of benefit in children.

Subcutaneous tenotomy is the method of tendon lengthening to be employed in a spastic condition of the gastrocnemius, to be followed by fixation by a plaster bandage in a corrected, but not over-corrected, position. After removal of the bandage in a fortnight, massage and electricity are to be employed and the patient permitted to walk as freely as the child desires. This exercise increases as the child's muscular and co-ordinated strength increases.

As Bullard well says: "This operation is to be considered as the first step in the treatment of the severer forms of cerebral spastic paralysis in children, but only at the first step. It needs to be followed by other measures in order that the full benefit should be obtained."—*Boston Children's Hospital Report*, Boston, 1895, p. 339.

Where the hamstring and adductor muscles are contracted, an open incision has seemed to give greater precision and to permit the more ready division of the intra-muscular fascia than tenotomy.

The principles of after-treatment are the same, viz.: fixation of limb in a correct position until healing, followed by gradually increasing exercise and massage.

I have employed the method also in the upper extremity, dividing the intra-muscular fascia in the muscular group attached to the internal condyle, to the biceps, pectoralis major, volar muscles of the thumb; where the method is followed by massage and muscle-training benefit will follow, though less than in the lower extremity.

Transplantation of the Ligamentum Patellæ in Slipping Patella.

It is to Shaffer that the credit belongs of first pointing out a lengthened condition of the ligamentum patellæ in some cases of slipping patella, and suggesting that this be cured by means of surgical intervention. Various procedures have been suggested for this, separation and transplantation of the tubercle of the tibia and the splitting and shortening of the tendon. The latter is much the simpler, and can be readily done. An oblique

incision is made dividing the ligamentum patellæ from above downward; the split ligament is pulled forcibly downward, and the lower portion is attached to the periosteum covering the tibia. The upper end of the lower portion of the ligament can be pulled forward and attached firmly to the side of the ligament. The same can be done to the cut surfaces, which can be slid past each other and quilted together; a free end can be attached to the periosteum on the inner side of the tubercle to broaden the attachment. This, accompanied by suturing a fold of the relaxed capsule, is sufficient to cure the distressing and disabling affection of slipping patella. This can be done without opening the joint, as the ligamentum patellæ is entirely separated from the joint capsule. A permanent cure may be expected.

The result in the case of slipping patella operated upon is most satisfactory, remaining permanently cured after two years of active usage. This is also true of a case reported by Dr. Goldthwait.

Dr. Dawbarn tells me that in a recent unpublished case he has successfully transplanted the ligamentum patellæ by chiselling the bone at the insertion of the ligament free from the rest of the tibia, and attaching the fragment of bone to the tibial periosteum dissected for the purpose at a lower and inner point on the tibia.

Results.

Tendon transplantation has been performed by my colleagues and myself at the Boston Children's Hospital in twenty-seven cases of infantile paralysis, chiefly those requiring transplantation of the peroneal tendons.

In two of my own cases in children under four years of age, but little benefit followed, the muscles apparently being too weak to justify an expectation of the future development of the muscle. In the other cases immediate gain of a hitherto unusual motion followed.

The ultimate result in cases watched for three years by Dr. Goldthwait was most satisfactory, the gain made after operation being increased under use.

In a case of transplantation of the sartorius operated upon by Dr. Goldthwait, the restored motion of extension of the leg remained with increased power two years after the operation.

Tenotomy and myotenotomy, with resulting tendon lengthening, has been performed in nineteen cases of spastic paraplegia and hemiplegia at the Children's Hospital, with satisfactory results in most instances, as recorded by Bullard.—*Children's Hospital Reports*, Boston, 1895, p. 338.

My experience in private practice accords also with hospital experience, and enables me to record permanent improvement from tendon lengthening in several instances of this affection watched through several years.

In conclusion, it can be safely claimed that teno-plastic surgery affords satisfactory results in affections hitherto untreated by operative surgery.

Bibliography.

Nicoladoni, C. Nachtrag zum Pes calcaneus und zur Transplantation der Peroneal-sehmen. Arch. f. klin. Chir., Berlin, 1881, 2, xxvii. 660–666.

Goldthwait, J. E. Tendon Transplantation in the Treatment of Deformities Resulting from Infantile Paralysis. Boston Med. and Surg. Journ., 1895, cxxxiii.

Milliken. Tendon Grafting: a New Operation for Deformities following Infantile Paralysis, with Report of a Successful Case. Med. Record, N. Y., 1895, xlviii. 581.

Franke, Felix. Ueber Sehnenüberpflanzung. Archiv. für klin. Chir., 52, 1896, p. 87.

Drobruik. Weitere Erfahrungen über die Behandlung der Kinderlahmüngen. Neurolog. Centralblatt, 1895, No. 2.

Winkelmann, K. Zür chirurgischen Behandlung des paralytischen Klumpfusse, Deutsche Zeitschr. für Chir., Bd. xxxix. S. 109.

Lipburger. Beitrag zur Sehmentransplantation. Centralblatt f. Chir., 1895, No. 22.

Hacker. Behandlung des Pes calcaneus paralyticus mit Transplantation der Peroneus in die Achillessehne. Wien. med. Presse, 1886.

Phocas. Transplantation musculo-tendineuse dans le pied bot paralytique. Rev. d'orthopédie, 1893, No. 6; Centralblatt f. Chir., 1894, No. 12.

Parrish. New York Medical Journal, 1892.

Ghillini. Pes. valgus paralyticus. Neues Verfahren der Schnentransplantation. Centralblatt f. Chir., 1895.

Milliken. Sartorius Transplantation. N. Y. Med. Record, Oct. 28, 1896.

DISCUSSION.

Dr. De Forest Willard, of Phiadelphia.

I have tested this question in a number of cases of paralysis of muscles of the upper and lower extremities, and consider it a valuable addition to our means of operation. In certain cases of paralysis of the tibialis anticus the tendon of this muscle may be attached to the extensor tendon of the toes, which is often quite strong, and the result is usually very helpful. My experience is limited, but the results have been very satisfactory in cases where a muscle in the neighborhood of an enfeebled one has been strong and vigorous. Considerable power has been secured, say from 10 to 40 per cent., and the patients have been able to walk much more vigorously. I am encouraged to still further test the operation.

Dr. Bradford. I merely wish to refer to the fact that Dr. Dawbarn has just told me that last October he transferred the insertion of the ligamentum patella by chiselling off the tubercle to which it is attached, crushing a portion of the bone and inserting the tubercle there. This is an operation I had thought of, but Prof. Dawbarn is the first to perform it.

THE SURGICAL TREATMENT OF SUPPURATIVE PERICARDITIS.

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(*A contribution from the Surgical Laboratory of the Philadelphia Polyclinic.*)

THE invitation to open the discussion on this topic has been accepted with pleasure, because I have long been interested in pericardial surgery. Studies made some twenty years ago convinced me that effusions in the pericardium should be treated by surgical measures similar to those adopted in pleural accumulations. At that time (1876) I suggested that purulent pericarditis be treated by the insertion of a drainage-tube into the pericardial cavity.[1] The proposal was thought by many to be rash and unworthy of surgical consideration.

Rosenstein, however, adopted this method of dealing with the disease in 1879, and saved his patient. He was followed by West in 1882, with equally gratifying success. It has been supposed that these were the earliest recorded cases in which the suppuration within the pericardium had been treated by incision and permanent drainage. Within a few weeks, however, I have found reported[2] the case of Hilsmann [Case I.]. He operated in 1844 upon a man, who had been sick about eight months, and evacuated several tumblerfuls of pus by an incision in the fourth intercostal space. The opening was kept patulous by the frequent insertion of a probe. The patient recovered.

[1] New York Medical Journal, December, 1876,. Idem, April 1877, p. 384. Paracentesis of the Pericardium, Phila., 1880, p. 55.

[2] Ueber die Paracentese des Pericardiums. F. H. Hilsmann, Kiel, 1875.

Langenbeck,[1] in 1850, treated with similar success a purulent pericarditis, occurring subsequent to necrosis of the ribs due to gunshot fracture [Case II.].

I reached the conclusion in 1881[2] that pericardial incision and suture of cardiac wounds might be successfully accomplished and should be undertaken. Dalton[3] within recent years has successfully resected six inches of the fourth rib, for stab-wound of the pericardium, and sutured the pericardial sac with a continuous catgut suture. Williams[4] successfully ligated wounded internal mammary vessels and stitched the pericardium in a patient who had been stabbed and received a wound of the heart-wall. He resected part of the fifth cartilage. The patient was well over three years later. Schnitzler[5] protected a torn pericardium with iodoform gauze when suturing was difficult. The pericardium has been torn, and the heart exposed during the resection of the thoracic wall for chondroma, and recovery has followed. Rehn recently showed,[6] at a meeting of German surgeons, a man upon whom he had, fourteen days previously, sutured a stab-wound of the right ventricle, after costal resection and enlargement of the pericardial wound. A stab-wound perforating the pericardium, going through the diaphragm, and injuring the liver, was treated successfully by Boufflleur,[7] who opened the abdomen and sutured the diaphragm. Ferraresi[8] resected three costal cartilages in a wound of the mammary artery and heart, and used gauze, applied with moderate pressure, to restrain the bleeding from the heart-wall. The injury of the cardiac muscle was not deep. His patient recovered.

These reports prove that the pericardium and heart do not

[1] Vorlesungen über Aklurgie. Berlin, 1888, p. 449.

[2] Annals of Anatomy and Surgery, December, 1881, p. 250, and Medical News, Jan. 13, 1883.

[3] Annals of Surgery, 1895, xxi. p. 147.

[4] New York Medical Record, March 27, 1897, p. 437.

[5] Rullier in Arch. de Méd. et de Pharm Militaire, January, 1896, p. 110.

[6] Medical News, December 5, 1896.

[7] Chicago Clinical Review (1892-93) i, p. 30.

[8] Gazz. Med. di Roma, 1896, xxii, p. 29.

resent a properly conducted surgical attack, and render a discussion of the topic selected valuable.

PERICARDOTOMY and provision for thorough drainage are always demanded by the presence of pus in the pericardial sac. The etiology of the purulent condition should have no influence in deciding the question of treatment.

The suppurative pericarditis may be primary—a rare condition; it may be secondary to serous or hemorrhagic pericarditis, to suppurative pleuritis or mediastinitis, to septic processes in distant regions, or to trauma; but the surgical indication is unvarying. Tubercular pericarditis, and pyopericardium, due to rupture into the pericardium of an abscess situated below the diaphragm[1] or elsewhere, require, in the same way, pericardotomy and removal of the puruloid or purulent accumulation.

The accessory treatment must be varied, in accordance with accompanying general or local deviations from the physiological state. Rheumatism, scurvy, pneumonitis, pleuritis, tuberculosis, empyema, abscess, and pyæmia require efficient medicinal and surgical therapeusis. The remedial measures employed for these conditions must never, however, be allowed to interfere with the instant and complete rescue of the heart from the dangers incident to the presence of pus in the pericardial cavity.

Let the attendant administer antirheumatic, antiscorbutic, tonic or other remedies, and aspirate, tap, or drain pleural sac or abscess cavity; but these important measures must not delay the essential incision into the pericardium.

The improbability of pus becoming absorbed, is great in all suppurative lesions; and caseation or absorption of puriform material in tubercular conditions does not generally occur. It has been said[2] that small pleural empyemas may undergo spontaneous cure, but this is by no means to be expected. Modern surgery seldom suspends its activity when purulent or puruloid deposits in any region are to be treated. Such deposits within the pericardium demand early evacuation even more imperatively. The mechanical effects of the hydrostatic pressure

[1] See Varga's case, Gaceta Médica de Mexico, xxii. 1887, p. 256.

[2] Parker: Trans. London Clinical Soc., 1889, xxii. p. 66.

on the heart's action and the degenerative changes indirectly produced in the cardiac muscle must be averted.

The diagnosis of pericardial exudation is made by the physical signs and the symptoms. That the fluid in the pericardium is pus must usually be demonstrated by exploratory aspiration. When this confirmatory evidence has been obtained, pericardotomy is to be performed with as little delay as is commensurate with satisfactory operative facilities.

Thick pus, shreds of floating lymph or false membrane, or a needle of too small calibre, may interfere with the demonstration expected by the use of aspiration. Under such circumstances the surgeon may be pardoned for delaying operative treatment a little while. A few days' time, not more, may be given to further study and therapeutic expectation. Then an exploratory incision down to the pericardium must be made, if the physical signs continue to suggest effusion.

Purulent pericarditis sometimes causes no fever and no local œdema. A dilated heart may present signs and symptoms so similar to pericarditis with effusion, that inspection of the heart or its surrounding sac may be the only means of ascertaining the truth. I recommended diagnostic incision in such obscure cases as long ago as 1881,[1] and have seen no reason to change my opinion as to its value and desirability. If there is a probability, therefore, that the patient's urgent symptoms are due to either pericardial effusion or cardiac dilatation, and competent medical examiners cannot determine the exact lesion, exploratory incision is to be adopted. If this establishes the fact of effusion, puncture of the exposed pericardium will prove, or disprove, the existence of pus or serum. If pus be found an incision should be made, and permanent drainage established by stitching the pericardium to the skin, or inserting tubular or gauze drains. Should the effusion prove to be serous, the puncture may be utilized to evacuate the entire quantity of effusion, and drainage may be omitted. The fluoroscope and skiagraphs will sometimes aid in diagnosis of obscure cases, but the apparatus is not always obtainable.

[1] Annals of Anatomy and Surgery, December, 1881, p. 250.

There is little dissent from the opinion that purulent accumulations in all regions require surgical intervention, lest the patient die of septic sequences or the pus be evacuated into neighboring cavities, before nature can provide for its spontaneous exit. The supposed vulnerability of the heart long prevented the application of this principle of treatment to the pericardium. As a consequence, patients died with several pints of pus in the pericardium;[1] and autopsies sometimes revealed a burrowing sinus reaching nearly to the surface, proving that the imprisoned pus was vigorously endeavoring to escape, that life might be saved.

Numerous recorded cases show the inutility in purulent cases of tapping, even if repeated. Gooch[2] tapped a case six times, and injected iodine solution. The patient died in thirty-eight days. The survival for such a long period suggests that the boy might have been saved if the purulent fluid had been evacuated by incision at the first operation. In a case reported by Doubleday,[3] seventeen pints of pus were withdrawn from the pericardium by ten aspirations in the course of thirty-four days. Then death occurred. In Villeneuve's case[4] recovery subsequent to pericardicentesis occurred after the persistence of a fistule at the seat of operation for nearly six months. The effusion was originally serous, but became purulent.

Death occurring after tapping has revealed great quantities of pus still in the pericardial sac, though large amounts had previously been removed. Smith found[5] thirty-six fluidounces at autopsy, though thirty fluidounces of pus had been withdrawn by aspiration. In some cases the original accumulation had been incompletely withdrawn; in others, more pus had formed and had been denied escape, because no permanent opening had

[1] In New York Medical Record, March 9, 1895, p. 314, is recorded a case in which 2600 cc. of pus and lymph were found at autopsy. See also British Medical Journal, 1888, ii, p. 1219. Gaz. Hebdom de Méd. et de Chir., January 12, 1883, p. 25, and British Medical Journal 1885, i, p. 1246.

[2] British Medical Journal, June 19, 1875.

[3] New York Medical Journal, September 1, 1888, p. 232.

[4] London Medical Record, September 15, 1875, p. 532.

[5] New York Medical Record, February 12, 1876, p. 110.

been provided. In an autopsy made by Parker, in a case not operated upon, the distended pericardium reached to the anterior vertical axillary line on both sides, and "sat like a saddle upon the lungs."[1]

Such observations show that aspiration and puncture afford only temporary relief in suppurative pericarditis, and that a free exit for the pus must be maintained for a varying length of time until the internal surfaces of the cavity become modified or mutually adherent. The entrance of air into the pericardium during this time does no harm.

DRAINAGE of the pus may be maintained by stitching the incised pericardium to the edges of the cutaneous wound, by the insertion of drainage-tubes or by the introduction of a gauze wick which must be frequently renewed. Stitching the pericardium to the edges of the wound has the advantage of possibly preventing pus leaking into the pleural sac, if it has been opened by the surgeon during the pericardotomy. The method of operating which I recommend avoids this contingency. If, however, the pleura is cut, suture of pericardium to skin is a judicious procedure when it can be done; for there is little doubt that secondary pleuritis, due to infection from leakage of the pericardial pus, is a real danger. Delorme and Mignon[2] report a case of suppurative pericarditis which died after tapping with a trocar in the fifth interspace 6 cm. to the left of the sternal border. Pleuritis occurred suddenly after the pericardial tapping. Autopsy showed that the pleura had been wounded, and the pus in the pleural sac had similar bacteriological characteristics to that in the pericardium.

If the pleura is known not to have been punctured, drainage by a large but short rubber tube is probably the best method. It does not need renewal as does the gauze wick, and can be utilized for irrigation if the surgeon decides to use irrigation. Two short drainage-tubes placed side by side, like the barrels of a double-barrel shotgun, is the most satisfactory in cases where irrigation is to be employed. The cleansing or anti-

[1] Trans. Clinical Society London, 1889, xxii. p. 63.
[2] Revue de Chirurgie, 1895, xv. p. 1016.

septic fluid is then allowed to flow in through one tube and out through the other, as in washing out the bladder by a two-way catheter. The catastrophe which happened in Parker's case (Case XIV.) would not then be likely to occur. His patient apparently died from pressure on the heart, made by the irrigating fluid failing to escape from the pericardial sac.

THE PROGNOSIS after incision and drainage is good, provided the operation is done early and no serious results have preceded the surgical treatment. West saw his first case nine years later in good health; and Davidson's case had no cardiac or pulmonary symptoms when seen nine months after operation. Many of the cases of death recorded in the subjoined statement are attributable to pyæmic infection, of which the pyo-pericardium was a mere incident. The relief due to the evacuation of the pus was great, but naturally it alone could not restore the patient to health; and he died of his general disease. In some cases death would probably have been averted if the pericardial condition had been promptly and efficiently treated. Delay causes myocarditis, cardiac debility, and exhaustion of the patient in secondary suppurative pericarditis; and in primary suppuration within the pericardium gives opportunity for general septic infection in addition to these risks.

The combination of pleuritis and pericarditis is quite frequent. It is probable that either may be the primary condition, leading to the other as a secondary inflammation by contiguity of structure or continuity of vascular connection. The histories in the statement seem to show that, in some instances at least, the pleuritis has been caused by the surgeon's pericardial puncture or incision being made through the pleural sac, and thereby permitting its direct infection from the pus in the pericardium. This can be avoided in nearly every case by a properly planned operative attack.

The prognosis is sure to be bad in cases where delay has permitted enormous quantities of pus to distend the long-suffering pericardial sac, the patient's strength to be exhausted, his kidneys congested, the cardiac muscle degenerated, and perhaps

the pericardial pus evacuated by ulceration into the bronchial tubes.[1]

The results obtained by incision and drainage in tubercular peritonitis suggest that drainage in tubercular pericarditis may lead to a permanent cure. The ease with which the pericardium can be irrigated with solutions of iodoform would seemingly add to this probability of success.

Results. In the list of thirty-five cases of suppurative pericarditis of all kinds treated by incision, fifteen recovered and twenty died. This gives a ratio of recovery of nearly 43 per cent. Of the fatal cases ten at least were evidently septic before operation. Excluding those known to be septic, only ten died out of the thirty-five cases. Of these ten there are complications, such as purulent pleuritis, or pleural, pulmonary, renal, or cardiac lesions mentioned in every instance, except one in which no statement is made (Case XXVIII.). Such a showing is very satisfactory when it is known that without operation practically all cases die, and that with repeated aspiration nearly every case reported has terminated fatally. The experience of Fiedler[2] and others shows that this statement is true.

In a few cases, as in that of Villeneuve,[3] aspiration has been followed by recovery because nature established drainage by the formation of a fistule. Doubleday[4] states that Wyss reports a case of pyopericarditis in which a fistule formed spontaneously and lasted for years. Death finally occurred from an attack of acute pericarditis. In Newman's case (Case IX) aspiration was repeatedly performed, but after a month of this palliative treatment, drainage and subsequently incision were adopted. When death occurred a few days later it was discovered that nature had been endeavoring to supplement the surgical treatment by establishing in the second interspace a fistule from the pericardium to the surface. The canal had reached the subcutaneous tissue, but had not yet perforated the

[1] Allende's case. Revista de la Sociedad Medica Argentina, 1895, iv. p. 20.
[2] Sammlung Klinischer Vorträge, innere Medicine, 1891, No. 72.
[3] London Medical Record, September 15, 1875, p. 532.
[4] New York Medical Journal, September 1, 1888, p. 232.

skin. This case shows nature's contempt for anything less than complete evacuation of purulent effusions, and is an indication that the proper surgical treatment in suppurative pericarditis is incision and drainage.

It is true that Douglas[1] reported a case of pus in the pericardium treated by simple aspiration that had not died up to the time of the report. The report, however, was made only thirty days after operation, and then the patient was expectorating purulent matter, due possibly to a communication between the pyo-pericardium and bronchial tubes. This case therefore affords no argument in favor of delaying incision and drainage. Langenbeck[2] mentions a case which was cured after the use of the trocar, but he gives no details. The trocar may have been so used as to permit of permanent drainage.

Incision has also the advantage of reducing to a minimum the danger of wounding the heart. This organ has been punctured on a number of occasions in attempts to tap a distended pericardium with a trocar or an aspirating needle. Sometimes this has occurred from a mistaken diagnosis. It may also happen, however, because the heart has become adherent to the anterior wall of the pericardium. Even with such adhesion a large and dangerously oppressive effusion may exist behind and at the sides of the heart. Diagnosis may then be difficult because the heart-sounds will not be muffled.

Barlow reports[3] experimental punctures made after death on two cases of pericardial effusion. All the punctures made to the left of the sternum resulted in the aspirating needle entering the heart wall and obtaining no fluid; but punctures made at the right side of the sternum reached the effusion without cardiac injury. The distinctness of the heart-sounds during life induced him to hesitate in adopting pericardicentesis, for the diagnosis was not certain. If he had aspirated in the

[1] Trans. Detroit Medical Library Association, January, 1879, and Paracentesis of the Pericardium. John B. Roberts, Phila., 1880, p. 93.

[2] Vorlesungen über Akiurgie, Berlin, 1888, p. 450.

[3] British Medical Journal, December 1, 1888, p. 1220. See also Churton: Trans. Clinical Society of London, xxv. p. 43.

usually accepted locations he would have injured the heart and would have obtained no fluid. If, however, he had adopted incision, as recommended in this paper, the diagnosis would have been cleared up, the fluid found, and the lives of the patients possibly saved.

Money relates[1] a very remarkable case where at autopsy twenty-four fluidounces of pus were found in the pericardium "almost entirely stowed away behind the heart." The amount was not appreciated even when the chest was opened until the heart was moved. I and others have invented peculiar aspirating needles to avoid wounding the heart when the effusion has been nearly all evacuated; but these devices will not avert puncture of an adherent heart or evacuate serum or pus confined behind the heart by intrapericardial adhesions.

Delorme and Mignon found[2] in one of their dissections a vein of such size lying on the front of the pericardium that a free hemorrhage would have resulted from its puncture. Such a complication is avoided by operating by an incision, which also prevents injury to the internal mammary veins and artery, should they be unusually located.

These observations, and other reported cases not here mentioned, have almost convinced me that incision is better than aspiration even in cases not supposed to be purulent. It establishes diagnosis in dubious cases, avoids cardiac injury, saves the pleura from puncture, affords complete evacuation of effusion, permits extraction of thick pus and membranous lymph, and gives opportunity for disinfection of the sac when that is necessary. Rullier[3] found it necessary to finally incise and drain a serous pericarditis which he had previously aspirated four times, even following the aspiration on two occasions with injections of tincture of iodine. The incision was done under local anæsthesia with cocaine. The patient recovered.

Irrigation has been adopted as an adjunct to incision in a number of cases. No immediate harm has seemed to result

[1] Lancet, October 18, 1890, p. 818.
[2] Revue de Chirurgie, 1895, p. 829.
[3] Arch. de Méd. et de Chirurgie militaire, January, 1896, p. 7.

except in Parker's case (Case XIV.). The child in that instance died during the irrigation immediately after the incision, apparently from pressure on the heart exerted by the irrigating fluid. Irrigation was used to encourage the evacuation of the thick pus which did not flow well; but the water did not escape on account of the pericardial opening becoming plugged with thick pus or membranous lymph. The child was pyæmic, and the heart, which was very weak, stopped beating.

It is certainly essential that the outflow of fluid be unimpeded when irrigation is employed. The fact that plugging, sufficient to prevent the escape of the irrigating fluid, occurred in this case would seem to indicate that something more than incision was needed to empty the pericardium of the fibro-purulent material clogging the heart's action. Parker believes that he would have done better if he had given the heart a little time to recover strength after the first gush of pus, before endeavoring to clear out the sac by irrigation. This would probably have been judicious.

The opinion of Sievers,[1] that irrigation tends to produce adhesions and may delay convalescence, is difficult to accept. The occurrence of intrapericardial adhesions to a greater or less extent would seem usually probable in suppurative pericarditis treated by evacuation; but Case XVIII. seems to indicate that they need not occur.

More than one autopsy made a long time after recovery from pericardicentesis, in non-suppurative cases, has shown the presence of adhesions. These were formerly thought to be the essential of cure. Pepper's case[2] showed complete adhesion fifteen months after aspiration.

Irrigation carefully performed, with warm fluid gradually admitted to the pericardium and given free vent by using two parallel drainage-tubes in the wound, ought to be beneficial in ridding the cavity of shreds of lymph and pus, and may perhaps modify the walls of the sac. I should prefer sterile salt

[1] Zeitsch. für klin. Med., 1893, xxiii. p. 45.

[2] Paracentesis of the Pericardium. John B. Roberts, Philadelphia, 1880, p. 79, and New York Medical Journal, December 1876.

solution at about 100° or 105° F., and would use it in cases in which there was much lymph mixed with the pus. If the heart is very weak it may be wise to wait for a few hours after the pericardotomy. Daily repetition of the irrigation seems desirable if the drainage instituted does not keep the sac empty.

Weak antiseptic solutions are unobjectionable for irrigation, but probably unnecessary. It has been suggested that the reflex irritability of the heart is modified by the false membranes, and that consequently irritants applied by irrigation cause little cardiac disturbance. I would not inject solution of hydrogen dioxide into the sac lest the effervescence within the cavity cause injurious cardiac pressure.

The direct extraction of shreds and membranous sheets by fingers and forceps is certainly judicious when they can be seen or felt. Exploration of the interior of the pericardium with the finger and palpation of the heart itself are not objectionable under appropriate circumstances.

If the pyo-pericardium is one in which the pus is free from lymph and flows freely, irrigation may be unnecessary.

THE SITUATION at which the pericardium should be opened by simple tapping and by open incision deserves careful attention. In a former study[1] I reached the conclusion that the two best points for pericardicentesis were close to the base of the ensiform cartilage in the fossa between it and the seventh left costal cartilage and the fifth left intercostal space, at from 5 to 6 cm. (2 to 2¼ inches) to the left of the median line of the sternum. Of these two points preference was given to the latter for aspiration, even though its selection rendered perforation of the pleural cavity almost certain, but the importance of avoiding pleural injury in cases treated with a drainage-tube was recognized.

The puncture near the ensiform cartilage was regarded as an efficient route to the pericardium, and one pretty sure to make the needle enter the pericardium without wounding either pleural sac. The chief risk in this location, perhaps, is that the diaphragm may be punctured if pericardial effusion is not present or if the surgeon does not direct the needle a little upward as

[1] Paracentesis of the Pericardium. Phila., 1880, pp. 65 and 67.

he perforates the thoracic wall. Rotch's point in the fifth interspace at 4½–5 cm. to the right of the edge of the sternum is objectionable because it opens the right pleura.

The danger of infecting the left pleural cavity by the pus within a pyo-pericardium, when the pericardium is punctured or incised in a location which causes a penetrating wound of the pleural sac, is not a theoretical one. This is shown by cases in which serous or suppurative pleuritis has arisen after pericardicentesis or pericardotomy in the usually selected locations known to open the pleura.[1] While it is true that pleuritis may occur as the primary condition and pericarditis as the secondary lesion, or that both may arise from the same cause, clinical and bacteriological experience seems to show that direct infection from the pericardium to the pleura is a real danger. It is probably much less real, to be sure, in cases of hydropericardium or serous pericarditis than in suppurative pericarditis, since the effusion is apt to be less infective in character.

Ferrand[2] believes the point of election for tapping the pericardium to be in the fifth intercostal space in a line vertically below the nipple when the effusion is moderate, in the sixth intercostal space on the same vertical line, if the signs denote a large effusion. He arrived at these conclusions by studying the limits of the pericardium and the downward displacement of the diaphragm after experimental introduction of fluid. He found that the arch of the diaphragm was lowered about 2 cm. in the recumbent position when 600 grammes of fluid were introduced, and that the depression was 3 cm. when the cadaver was put in a sitting posture. With 1100 grammes of plaster solution in the sac the cardiac apex at the left angle of the pericardium was at least 6 cm. from the thoracic wall. Delorme and Mignon found[3] the pericardium to be from 3 cm. to 5 cm. from the surface of the skin in cadavers.

[1] British Medical Journal, December 1, 1888, p. 1220. North American Journal of Homœopathy, New York, June, 1889, p. 392. See Cases III., XXXII., and XXXIV. in Summary at end of this article. Ashby's case of pericardial tapping through lung from scapular angle is interesting. Lancet, March 29, 1884, p. 560

[2] Contribution a l'Étude de la Paracentèse du Péricarde, Bordeaux, 1883. p. 45.

[3] Revue de Chirurgie, December, 1895, p. 830.

Ferrand's points would puncture the pleural sac and are, therefore as unsatisfactory as that recommended by me in the fifth interspace.

Numerous dissections made by Delorme and Mignon[1] show that the edge of the left pleura is very variable in its relation to the left border of the sternum, and that the accepted points of puncture on the left side must often wound the pleura. This observation holds good for infants as well as adults. Puncture in the fifth and sixth interspace close to the sternum will not assure safety to the pleura, though it was formerly thought that here the pleura was out of harm's way.

That pathological lesions change the pleural relations to the pericardium very little was apparently proved by their dissection of cases of pericarditis and by injecting fluid into the pericardium. This is not surprising when it is recollected that the parietal pleura is fixed to the thoracic wall.

The statement made by Fowler[2] that the boundaries of the pleura are greatly displaced in pericardial distention is, I believe, erroneous. The lungs are usually displaced, and may be thrust far backward by the distended pericardium sitting upon them like a saddle, but the pleuræ seem to hold their usual relations to the anterior wall. Of course the two layers may in some cases become adherent by a local pleuritis, and thus lead to local obliteration of the pleural cavity.

My dissections lead me to believe that Delorme and Mignon are correct in stating that the pleura is in great danger of injury from the punctures usually made. The left pleura in many dissections made by these writers was out of the way, however, of a puncture made in the left xiphoid fossa.

These considerations lead me to the conclusion that, in cases of suspected suppurative pericarditis, the exploratory aspiration to determine with certainty the existence of pus in the pericardium should be performed in the upper part of the left xiphoid fossa. The needle should be thrust upward a little and toward the median line of the sternum. In fat persons a small cutane-

[1] Revue de Chirurgie, December, 1895, and January, 1896.

[2] TRANSACTIONS AMERICAN SURGICAL ASSOCIATION, 1896, xiv. p. 161.

Sklagraph of a cadaver, in the pericardium of which about 740 c.c. of plaster-of-Paris solution had been injected. Tacks were thrust into the chest at the points recommended for aspiration by Rotch, Ferrand, and Roberts. The nipples are marked by buttons.

ous incision should be made if it is difficult to locate with certainty the top of the xiphoid fossa. If this establishes the diagnosis, the pericardium should be incised and drained by resection of the fourth and fifth costal cartilages on the left side of the sternum in the manner devised by me and described hereafter.

It is probable that even in non-suppurative pericardial effusions the left xiphoid fossa is the place of election for aspiratory puncture, but it does not afford room for incision and drainage. Hence, in suppurative cases costal resection is to be adopted, because the pleura can then be readily pushed aside, the internal mammary artery, which may be as large as the radial, preserved from injury, and the surgeon have room for extraction of membranes or clots or for any intrapericardial manipulation demanding fingers or forceps.

More than one instance is recorded where an incision or puncture evacuated the pericardial effusion, found to exist, into or through the left pleural cavity. In some cases the operation was performed for a supposed pleural effusion, but a distended pericardium was found to exist, and was then tapped through the original wound. The cases of West (VI.), Savory (VII.), and Gussenbauer (XI.), are illustrations of this error of diagnosis.

West speaks[1] of a purulent pleuritis in which the needle, after being thrust into the pleural sac and obtaining pus, failed to perforate the pericardium. The pericardial symptoms diminished, and he believed that the pericardium had been nicked and had then drained into the pleura.

Resection of the thoracic wall for obtaining access to the pericardium has been proposed or done by Ollier, Durand,[2] Delorme and Mignon,[3] and Williams. Durand's[4] operation is a modification of that recommended by Ollier, and consists of the following steps:

[1] British Medical Journal, December 1, 1888, p. 1220.
[2] Revue de Chirurgie, 1896, No. 6.
[3] Ibid., December, 1895, and January, 1896.
[4] New York Medical Record, March 27, 1897, p. 437.

"A cutaneous incision on the fifth costal cartilage parallel to it and from 6 to 8 cm. in length. It should commence at the middle line.

"Isolation and rapid denudation of the cartilage with the aid of the bistoury.

"Resection of this cartilage, which should be commenced by separating it from its sternal attachments and raising it from within outward.

"To these fundamental manœuvres is added ligature of the internal mammary vessels at the upper and lower borders of the wound. These organs are thus put out of danger of secondary ulceration or of accidental perforation during the operation. The fingers then detach the triangularis sterni; the operative importance of which Delorme and Mignon have clearly shown. The fingers are then carried toward the middle line *under the sternum* and recognize the pleura. The distended pericardium is then seen. Displacement of the pleural sac is then attempted, the situation of which sac scarcely appears to be changed by the pericardial distention."

At this moment, if the displacement of the pleura is insufficient, or if the pericardium is hidden behind the sternum, the border of the sternum is cut away.

"Incision of the pericardium, which is widely accessible to sight and touch."

After some little work on the cadaver I propose the following operation for pericardotomy. The details are, I believe, in some respects new, though the writers just mentioned have suggested similar methods. After I had proved to my satisfaction the efficiency of the method on the dead subject, and its reliability in avoiding pleural wound, I was gratified to find that much the same method of opening the thorax, used by Williams[4] in a case of stab-wound requiring pericardial suture, had healed favorably. His operation was not devised to prevent pleural injury, but to get access to a wounded internal mammary artery. I had supposed my method entirely novel until I recently saw his paper.

[4] Loc. cit.

Author's Chondro-plastic Method of Pericardotomy, by a Trap-door Excision of Costal Cartilages, which avoids Injury to the Pleura and Internal Mammary Vessels.

[The flap, consisting of portions of the fourth and fifth cartilages and the attached soft parts, is turned upward, exposing the left lung covered with pleura and the internal mammary vessels. The forceps is seen holding the vessels and the edge of the pleural sac outward, so as to expose the white pericardium, in which an opening, indicated in black, has been made.]

My dead-house investigations and his experience on the living patient supplement each other in a way that convinces me of the admirable character of the operative procedure which I advocate.

The operation consists in making a sort of trap-door, consisting of portions of the fourth and fifth costal cartilages, which is turned upward by utilizing for a hinge the soft tissues in the third intercostal space. A vertical incision is made about 1 cm. to the left of the median line of the sternum, beginning on a level with the top of the fourth costal cartilage. This cut is carried through the skin and subcutaneous tissue to the sternum, and is continued downward to a point corresponding with the level of the upper border of the sixth cartilage. The length of this incision is from 4 to 5 cm.

A second incision is made parallel to the first and beginning at the upper border of the fourth rib at from 4 to 5 cm. to the left of the commencement of the first incision. It is continued downward from the top of the fourth cartilage to the upper border of the sixth cartilage. The curve of the sixth cartilage requires this excision to extend downward a little further than the first vertical incision; but as the fourth rib also is a little concave upward, the second cut is nearly of the same length as the first. The second incision is made deep enough to divide all the tissues down to the cartilages. The lower ends of these two incisions are joined by a third cut carried along the upper border of the sixth costal cartilage.

The soft tissues to the left of the first incision are separated from the sternum and pushed outward, so as to disclose the exact situation of the articulation of the fourth and fifth costal cartilages with the sternum. With a large scalpel having a thick back, the fourth and fifth cartilages are divided as near as possible to the sternal border in such a way as to leave a beveled surface of the cartilage attached to the sternum looking forward and outward. This section of the cartilages may be made with a Hey's saw if the surgeon prefers. A thick-backed scalpel, with a cutting edge having a large belly, will be found a satisfactory and safe instrument with which to divide the

cartilages with the least danger to the tissues in the mediastinum.

The next step consists in dividing the cartilages immediately under the outer edge of the flap in a similar manner, leaving a beveled surface to the portion left attached to the rib, which looks forward and inward toward the median line. The incision is near the junction of the ribs with the cartilages. Care must be observed to make the incision through the cartilage of the fifth rib vertically under the incision of the cartilage above. The tendency is to bring the incision inward toward the median line of the body, so that the opening made in the chest wall becomes too narrow at the bottom of the flap.

In dividing the cartilages the operator must be cautious not to puncture the pleura, which is closely attached to the inner surface of the costal cartilages at the outer margin of the flap. There is less danger in making the costal incision near the sternum, because in that region the muscular fibres of the triangularis muscle are immediately beneath the cartilages. The surgeon, having divided the cartilages completely, next cuts the intercostal muscles and soft tissues in the fourth and fifth intercostal spaces and along the upper border of the sixth cartilage.

The chondro-plastic flap is then carefully raised from its lower border, and the tissues of the mediastinum are cautiously separated from the internal surface of the resected cartilages and the intercostal muscles. The trap-door is thus opened on the hinge at the upper border and the triangularis muscle exposed. Upon it, about 1 cm. from the border of the sternum, is seen the internal mammary artery and its two accompanying veins running parallel to the sternal edge. At the outer portion of the window the muscular fibres and fascia are thinner and cover the lung and pleura. An incision is made through the triangularis muscle close to the sternum, and, therefore, within the line of the internal mammary vessels, and is carried up and down as far as the opening in the chest wall will permit.

With the finger or a curved blunt instrument the surgeon then separates the fascia and muscular fibres and pushes the outer part, with the vessels and the double edge of the pleural

sac, outward toward the external border of the opening. The shining white surface of the pericardium is then seen lying behind the sternum and along the inner portion of the opening. The pleura, which often has considerable fat along its edge like the appendages of the colon, may not be seen, because it is pushed out of the way without having the overlying fatty tissue separated from it. If it is seen its transparency or pinkish color will distinguish it from the white and more opaque pericardium.

Injury to the vessels or pleura is thus averted during the pericardotomy, because they are pushed away from the proposed opening into the pericardium. The pericardial sac is incised vertically or obliquely between the sternal border and the displaced vessels and pleura, and a drainage-tube inserted. The length of the incision into the pericardium should be sufficient to permit extraction of membranes and thick pus. The surgeon's finger may be introduced for exploration.

If irrigation is employed it is best to use two tubes, one to admit the fluid, the other to give it free exit. The drainage-tubes are introduced and brought to the surface through the fifth intercostal space, after trimming away the lower portion of the flap; and the chondro-plastic flap is laid in position. If preferred, the tubes may be brought out through holes made in the flap between the fourth and fifth cartilages. The beveled cartilages fit accurately together, and the flap will show little tendency to drop inward, even if the lungs and pericardium fail to support it. The cartilages may be sutured with catgut by passing the needle through their ubstance. In cutting the cartilages obliquely during the early part of the operation it is desirable not to bevel them too much, because the internal edges then project so far that it is difficult to get under the sternum. The beveled surface should make an angle of about 45° with the internal surface of the cartilage.

It may be objected that this method of resecting the thoracic cage does not open the pericardium at its very bottom. It might be suggested to resect the fifth and sixth cartilages instead of the fourth and fifth. I prefer not to do this, because there is

considerable danger of opening the abdomen when separting the outer end of the sixth cartilage from the underlying tissues. This danger would be less, of course, if a pericardial effusion had pushed the diaphragm downward. The manner in which the outer portion of the costal cartilage of the sixth rib runs obliquely downward renders the danger more imminent than might be supposed. Another objection to resecting the sixth cartilage is the common presence of a cartilaginous bridge between the sixth and seventh costal cartilages. This would complicate a little, though not to a great extent, the lifting up of the trap-door. Such a bridge sometimes occurs between the fifth and sixth cartilages.

Operators who have made similar resections of the chest-wall in operations for suppurative pleuritis have proved by skiagraphy that consolidation takes place if the perichondrium be retained. Restoration would certainly be much more probable in the operation which is here advocated, since not only the perichondrium, but the cartilages themselves, with many of their connections, have been retained.

The evacuation of the fluid, after opening the pericardium, can be made complete at times by a change in the posture of the patient, or breaking down adhesions by the probe or the finger introduced into the sac. It does not seem to be especially dangerous to allow the pus to flow out rapidly, but it is wise to permit the escape to be gradual.

Aspiration can be readily done under local anæsthesia by cocaine or freezing. Resection in the manner advocated, will, probably require general anæsthesia. If the severity of the symptoms renders general anæsthesia dangerous, it may be well to withdraw a portion of the fluid by the aspirator needle used for diagnosis in the xiphoid fossa, and delay drainage by incision and resection until the patient's condition will permit the administration of an anæsthetic. The patient should be allowed to remain recumbent or semi-recumbent during the operation. The tubes should be prevented from slipping into the pericardium by being stitched to the skin, or having a safety-pin thrust through their outer ends.

Operations upon the pericardium for pyo-pericardium, would seem, on general principles, to promise better results in a mechanical way than similar operations upon the pleura; for the pericardium is elastic and more easily drained than the pleura. If it becomes thickened, and does not collapse after evacuation of pus, I would be inclined to incise any remaining fistule and cut away the thickened pericardial tissue.

Pericardial fistules should be treated as fistules elsewhere. After sufficient time has been given to make it clear that spontaneous healing will not occur, the fistule should be laid open and thickened tissue removed.

Cases of Suppurative Pericarditis Treated by Incision.

[This list contains the cases of Porter and Allen, reported in the discussion on my paper, and also the case of Garber, published while this article was in the hands of the printer.—J. B. R.]

Case I. (Hilsmann, "Ueber die Paracentese des Pericardiums." Kiel, 1875. Inaug. Dissert.) Date of operation, 1844. Male, aged twenty-five years. Ill eight months. No complication. Not tapped previously. Incision, fourth interspace, a finger's breadth from left edge of sternum. Four tumblerfuls of pus evacuated: much more escaped within a few hours after operation. No irrigation of pericardium. Permanent drainage; wound kept open by inserting probe. After-treatment, nearly three months. Recovered. The pericardium was opened behind the sternum, though the external wound was a short distance to left of sternum. As the sac was gradually drained, its walls contracted and the pericardial opening moved to the left. In a few days the opening was one and one-half inches to left of sternum and over the fourth rib. In order to empty the sac thoroughly when the external wound was dressed the patient had to bend over as if he was about to stand on his head.

Case II. (Langenbeck, *Vorlesungen über Akiurgie*. Berlin, 1888, p. 449.) Date of operation, 1850. Gunshot wound and necrosis of ribs. Not tapped previously. Incision, where fifth rib was absent. No irrigation. Recovered. Patient had been wounded in a duel in which the bullet shattered five ribs. Necrosis had subsequently occurred, and purulent pericarditis resulted.

Case III. (Rosenstein, *Berlin. klin. Wochenschrift*, January 31, 1881, p. 62.) Date of operation, 1879. Male, aged ten years. Ill twenty-eight days. Pleuritis a complication. Tapped twice a few days previously with aspirator; pleura also tapped. Incision, fourth interspace near sternum. Great quantity of pus evacuated. No irrigation. Permanent drainage, with two drainage-tubes. After-treatment, about two months. Recovered. Pleuritis apparently occurred after tapping and incision of pericardium.

Case IV. (West, *Medico-Chirurgical Transactions*, 1883, p. 235.) Date of operation, 1882. Male, aged sixteen years. Ill one month. No complication. Tapped three days previously. Incision, fifth interspace, in line of left nipple. Two quarts of pus evacuated. Irrigation, carbolic acid solution, 1 : 40. Permanent drainage, with drainage-tube. After-treatment, five months. Recovered. Rod-shaped bacteria found in pus. Patient

in good health nine years afterward. West believes that pericardial adhesions had occurred, but there was no evidence of this condition.

Case V. (Partzevsky, *London Medical Record*, February 15, 1883, p. 33). Date of operation, 1882. (?) Male, aged twenty-three years. Ill thirteen weeks. Pleuritis a complication. Tapped twice. Incision, fourth interspace. Irrigation, salicylic acid solution. Permanent drainage, with drainage-tube. After-treatment, thirty hours. Death. Autopsy showed cardiac hypertrophy with fatty degeneration, pleural adhesions and pulmonary œdema.

Case VI. (West, *British Med. Journ.*, December 8, 1883, p. 1129, and February 21, 1891, p. 404.) Date of operation, 1883. Male, aged fourteen years. Pleuritis, pneumonia, abscess of thigh, arthritis, were complications. Pericardium opened with bistoury, from wound made to evacuate a supposed pleural effusion. Twenty-four fluidounces of pus evacuated. After treatment, fourteen days. Death. At autopsy found extensive pericardial adhesions. [Case evidently of a septic nature.—J. B. R.]

Case VII. (Savory (?), reported by Brinton and Collyns, *St. Bartholomew's Hospital Reports*, 1883, vol. xix. p. 271.) Date of operation, 1883. Male, aged nine years. Ill seven weeks. Abscess of shoulder and thigh, pleuritis, pneumonia as complications. Serum obtained from pleura at two previous tappings. Incision, fifth interspace in anterior line of axilla through pleural cavity, which was opened because effusion believed to be pleural. Twenty-four fluidounces of pus evacuated. Irrigation, Condy's fluid. Permanent drainage with drainage-tube. After treatment, fifteen days. Death. This patient is evidently the one referred to by West in the *Medico-Chirurgical Transactions* of 1883 as having been operated upon by Savory. Case was one of pyæmia. Autopsy showed no communication between left pleura and the track leading through it to pericardium, because adhesions had occurred.

Case VIII. (Scott, *New Zealand Med. Journ.*, July, 1891, p. 268.) Date of operation, 1883. Male, aged six years. Ill five weeks. No complication. Tapped with trocar one day previously; irrigation with carbolic acid solution, 1 per cent. Incision, fifth interspace near apex-beat. Irrigation, carbolic acid solution, 1¼ per cent. Permanent drainage; two openings an inch apart, with drainage-tube through both. Recovered.

Case IX. (Newman or Stirling), *Australian Med. Journ.*, July 15, 1885, p. 303.) Date of operation, 1885. Male, aged thirty-two years. Ill two months. Typhoid fever and pleuritis were complications. Aspiration, five times; fifth time, silver canula allowed to remain for drainage: at fifth tapping carbolic acid solution and tincture of iodine solution used for irrigation; first aspiration one month previously. Incision, third left interspace: incision made where fistula existed from canula, which had been draining the sac for three days. One hundred and seventy-four fluidounces of pus had been evacuated by five previous tappings. Irrigation with tincture of iodine (B. Pharm.), 1 : 10. Permanent drainage with rubber-tube. After-treatment, five days. Death. First aspiration was done in sixth left interspace; second, in fourth right interspace; in third and fourth aspirations no information as to point is given; fifth tapping done in third left interspace. At autopsy a sinus found in second interspace leading from pericardium to the subcutaneous tissue. This was nature's effort to obtain a spontaneous opening for the pus. The author suggests to us that it may give a hint as to the best point for tapping.

Case X. (Mikhailov, *Med. Oboz.*, Moscow, 1885, xxiii. p. 475; *Annals of Surgery*, November, 1885, quoted from *London Med. Record*, August 15, 1885.) Date of operation, 1885 (?) Female, aged thirty-five years. Ill about three weeks. Pleural, bronchial, and renal lesions as complications. Tapped two days previously. Incision, fourth interspace, near sternum. Two fluid-pounds (?) of pus evacuated. Irrigation with boric acid solution. Permanent drainage with drainage-tube. After-treatment, eighteen

hours. Death. Autopsy showed cardiac dilatation with fatty degeneration, pleural and bronchial disease and kidney lesions. Bacteriological examination of heart and pericardium were negative.

CASE XI. (Gussenbauer, *Wiener med. Wochenschrift*, November 22, 1884, p. 1403.) Date of operation, 1885. (?) Male, aged thirteen years. Acute osteomyelitis of left shoulder as complication. Incision, fifth rib resected; opened pericardium through pleural cavity, because supposed to be pleural effusion. Irrigation with thymol solution. Permanent drainage by stitching pericardium to edges of wound. Recovered. Small fistule remained when case was reported.

CASE XII. (Rouse (Dickinson's patient), *Trans. Clin. Society*, London, 1889, p. 48.) Date of operation, 1887. Male, aged ten years. Ill about fifteen weeks. Gluteal abscess, pleuritis, abscess of finger as complications. Pleura tapped twelve times; serum obtained. Tapped pericardium three times; last time one week previously. Incision, fifth interspace, right side, close to sternum. No irrigation. Permanent drainage with drainage-tube. After-treatment, two and one-half months. Recovered. Case considered one of pyæmia. Patient lay on face at times to encourage drainage.

CASE XIII. (Underhill, *Edinburgh Hospital Reports*, 1896, iv. p. 200.) Date of operation, 1887. Female, aged six years. Ill two days. Pyæmia; had periosteal abscess of tibia a few weeks previously; autopsy showed abscesses in kidneys and pleura. Aspirated twice, last time five days before incision. Incision, fifth left interspace, close to border of sternum. Over ten fluidounces of pus evacuated. No irrigation. Permanent drainage with drainage-tube. After-treatment, five days. Death. Several hemorrhages from interior of pericardium. Autopsy showed that the bleeding probably came from granulation-tissue on inner surface of pericardium, probably the seat of septic emboli.

CASE XIV. (Parker, *Trans. Clin. Society*, London, 1889, vol. xxii. p. 60.) Date of operation, 1888. Female, aged nine years. Ill six and one-half weeks. Osteomyelitis of tibia and suppurative arthritis of knee as complications. Tapped four days previously. Incision, fourth interspace; along left border of sternum, with resection of one inch of fifth costal cartilage. A large quantity of pus and lymph evacuated. Irrigated. Permanent drainage; stitched pericardium to edges of wound. Death occurred during irrigation immediately after incision. Pus did not flow well; it was thick and contained membraniform shreds; hence irrigation was adopted. Operator believed death was caused by irrigating fluid collecting in pericardium, as the opening in pericardium became plugged with lymph. Pressure on heart proved fatal. Patient was pyæmic. No special lesion found in chest at autopsy except pericardial changes.

CASE XV. (Halsted, *University Med. Magazine*, vol. vi. p. 248.) Date of operation, 1890. Male, aged thirty-six years. Ill over three weeks. Acute necrosis of bones of nose, albuminuria, and congestion of right lung as complications. Not tapped previously. Incision, fourth interspace midway between nipple and sternum. Over a quart of pus evacuated. No irrigation. Permanent drainage with gauze-plug After-treatment, seventeen days. Death. Great improvement after operation. Dr. Osler, who reports case, calls the pericarditis septic, and attributes the fatal result to a probable myocarditis. No autopsy was made.

CASE XVI. (Delorme, *Revue de Chirurgie*, 1895, vol. xv. p. 1008.) Date of operation, 1890. Male. Ill eighteen days. Double pleuritis as complication. Empyema operation. Not tapped previously. Incision, fourth interspace, a little outside of internal mammary vessels. A few drops of pus evacuated. No irrigation. After-treatment, a few moments. Death. Patient died of asphyxia, which had caused the pericardial operation to be hurriedly undertaken. Autopsy showed front of heart adherent to pericardium, and about 500 grammes of sero-pus collected at the base and sides of

the heart and a great quantity of false membranes, that could only have been removed by a large opening, followed by washing and direct extraction. The opening in the fourth space was over the adherent region.

CASE XVII. (Davidson, *British Med. Journ.*, March 14, 1891, p. 578.) Date of operation, 1890. Male, aged six years. Ill over four weeks. Metatarsal, necrosis; subperiosteal abscess at eighth rib on right side; empyema, pneumonia as complications. Not tapped previously. Incision at fifth interspace. Eight fluidounces evacuated. No irrigation. Permanent drainage with drainage-tube. After-treatment, seven days. Death. Autopsy showed no pericardial adhesions; pneumonia. Case was considered septic.

CASE XVIII. (Davidson, *British Med. Journ.*, March 14, 1891, p. 578.) Date of operation, 1890. Male, aged six and three-fourths years. Ill nearly four weeks. Empyema as complication. Operated upon previously. Not tapped previously. Incision, fourth interspace, one inch from left edge of sternum. Several fluidounces of pus evacuated. No irrigation. Permanent drainage with drainage-tube. After-treatment, over seven weeks. Recovered.

CASE XIX. (Teale (Bronner's patient), *British Med. Journ.*, February 14, 1891, p. 350.) Date of operation, 1890. Female, aged eleven years. Ill thirty-four days. Influenza, pneumonia, empyema as complications. Empyema operated on previously. Not tapped previously. Incision, fourth interspace, one inch from left edge of sternum. Nearly two pints of pus evacuated. Irrigation, iodoform and glycerin, solutions of boric acid and carbolic acid. Permanent drainage with drainage-tube. After-treatment, twenty-six days. Death. No autopsy made, but a probe passed into pericardium discovered no adhesions, though soft granulations were felt toward base of heart.

CASE XX. (Deaver, *University Med. Magazine*, 1894, vol. vi. p. 297.) Date of operation, 1890. Male, aged twenty-one years. Ill eighteen days. Synovitis (?) of knee as complication. Aspiration one day previously. Incision, fifth interspace, three inches from middle line. Not much pus evacuated, but seventeen fluidounces removed by aspiration day before. No irrigation. Permanent drainage with rubber-tube. After-treatment, thirteen days. Death. Autopsy showed much fibrinous exudate within pericardium. [Case of a septic nature, most probably.—J. B. R.]

CASE XXI. (Sievers, *Zeitsch. für klin. Med.*, 1893, xxiii. p. 26.) Date of operation, 1892. Female, aged twenty-two years. Ill five weeks. Pleuro-pneumonia, empyema on both sides, nephritis as complications. Tapped seven days previously with trocar. Incision, third interspace, two centimetres to left of sternum. Great quantity of pus evacuated. No irrigation. Permanent drainage. After-treatment, eight days. Death. Found bacilli in fluid. Autopsy showed acute nephritis, pleuro-pneumonia, pericardial adhesions, and some change in heart muscle. Pericarditis was of a septico-pyæmic nature. Operator chose third interspace, because fourth and fifth interspaces very narrow.

CASE XXII. (Körte, *Verhandl. d. Berl. med. Gesellsch.* (1892), 1893, xxiii. p. 2.) Date of operation, 1891. Female, aged seven years. Osteomyelitis of both tibiæ, as complication. Tapped previously. Incision with resection of five centimetres of fifth rib and cartilage. Evacuated half a litre of pus. Irrigation, lysol solution, ½ per cent. Permanent drainage not mentioned. After-treatment, twelve days. Death. Autopsy showed numerous foci of pus in fissures of cardiac muscle, in papillary muscle of mitral valve, and in kidneys. Caseous mass in lung and evidences of pleuritis were found. Pus evacuated contained staphylococci, streptococci, and bacilli. [Case evidently a septic one.—J. B. R.]

CASE XXIII. (Eiselsberg, *Wiener klin. Wochenschrift*, January 10, 1895, p. 21.) Date of operation, 1894. Male, aged seventeen years. Ill over four and one-half months. Wound made by knife in region of heart, which had healed; left pleuritis and

pneumonia followed third tapping. Tapped three times previously. Resection of fourth cartilage. Two litres of pus evacuated. Irrigation, solution of salicylic acid; then iodoform and glycerin. Permanent drainage, two tubes. After-treatment, about six weeks. Recovered. Drains kept in pericardium seventeen days.

CASE XXIV. (Edwards, *Trans. Med. Soc. of State of California*, 1893, p. 166.) Date of operation, 1892. (?) Female, aged six years. Sacculated empyema; operation with resection of ribs; mediastinitis, nephritis as complications. Not tapped previously. Incision, one-fourth inch within and above position of apex-beat. Nine fluidounces of pus evacuated. No irrigation. Permanent drainage with rubber-tube. Death. Began as mediastino-pericarditis, with secondary pleurisy. At least this was the belief of Edwards after an autopsy.

CASE XXV. (Jacobson, *Operations of Surgery*, London, 1897, p. 590.) Female, aged fourteen. Œdema of the lungs as complication. Incision, fifth interspace, right side, a little outside of sternum. Forty-six fluidounces of pus evacuated. Death occurred from œdema of lungs.

CASE XXVI. (Gabszewiez, *Gaz. Leklarsk*, Warsaw, 1892, 2 Ser. 12, p. 1070.) Date of operation, 1892. Male, aged twenty-two years. Ill about one month. No complications. Not tapped previously. Resection of fifth costal cartilage. Large quantity of pus evacuated. Irrigation, boric acid solution. Permanent drainage by iodoform-gauze for eighteen days. Recovered.

CASE XXVII. (Robinson, *Lancet*, November 21, 1896, p. 1460.) Date of operation, 1893. Male, aged sixteen years. Ill twenty days. Sore-throat and swelling of left wrist were first symptoms. Aspiration one day previous. Resection of sixth *rib*. Two quarts of pus evacuated. No irrigation. Permanent drainage with one drainage-tube. After-treatment, about two months. Recovered.

CASE XXVIII. (Marsh, *Lancet*, November 21, 1896, p. 1460.) Male, aged fourteen years. Incision below the nipple. No permanent drainage. After-treatment, four days. Death.

CASE XXIX. (Klefberg, *Tidskrift i Militär. Helsovord*, 17 Arg., 1892, Stockholm; from Shattuck and Porter, *Boston Medical and Surgical Journal*, May 6, 1897, p. 444.) Male, aged nineteen years. Influenza previously. Aspiration previously and withdrawal of one hundred and fifty grammes of pus. Incision in fourth interspace. One litre of pus evacuated. After-treatment, six days. Death. Autopsy showed pus in right ankle-joint and sterno-clavicular joint. [Probably septic.—J. B. R.]

CASE XXX. (Bohm, *Deutsche medicin. Wochenschrift*, November 26, 1896, p. 769.) Date of operation, 1894. Male, aged thirty-three years. Ill one month. Influenza previously. Pleuro-pneumonia as complication. Tapped pericardium three times. Incision in third interspace. One litre of pus evacuated. Irrigated with boric acid solution. Permanent drainage with gauze. After-treatment, three months. Recovered. Schleich's infiltration method of local anæsthesia was used. Wound closed in three weeks. Out of bed in four and a half weeks. Well a year later.

CASE XXXI. (Allen, personal communication from Dr. D. P. Allen, Cleveland, Ohio.) Date of operation, 1892. Male, aged eleven years. Empyema, requiring costal resection one year before. Aspiration of pericardium previously. Resection of sixth rib below and inside of left nipple. Two quarts of pus evacuated. Irrigation with sterile water. Permanent drainage with gauze. After-treatment, twenty days. Death.

CASE XXXII. (Stoker (O'Carroll's patient), *Dublin Journ. of Med. Science*, July, 1896, p. 11.) Date of operation, 1892. Male, aged twenty years. Ill thirty-four days. Pneumonia. Left pleural effusion subsequent to operation. Aspiration of pericardium five days previously. Incision in fourth interspace midway between nipple and sternum.

No irrigation. Permanent drainage on third day by tube. After-treatment, thirty days. Death. Fränkel's diplococcus found in pus.

CASE XXXIII. (Björkman or Hackzell, *Hygeia*, Stockholm, 1896, lviii. pt. 2, 189.) Date of operation, 1895. (?) Female, aged twelve years. Ill about three and a half weeks. Had influenza and pleuro-pneumonia previously. Aspirated previously in fourth interspace. Resection, fifth and sixth ribs. Evacuated from 400 to 500 c.c. of pus. Irrigation with boric acid solution. Permanent drainage with two drainage-tubes. Duration of treatment six weeks. Recovered. Pleural cavity was opened and some serum evacuated by resection. The pleural opening was then closed with sutures.

CASE XXXIV. (Porter (Shattuck's patient), *Boston Medical and Surgical Journal*, May 6, 1897. p. 438.) Date of operation, 1895. Male, aged twenty-six years. Ill thirty-three days. Pneumonia before pericarditis. Empyema after pericardotomy, requiring resection. Aspiration two days previously. Incision in fifth interspace one and one-half inches to left of sternum. One quart of pus evacuated. Irrigation with sterile salt solution. Permanent drainage with two rubber tubes. Recovered. Pneumococcus found in pus. Pneumo-thorax and empyema occurred after pericardotomy. Pneumococcus in pus from pleural sac. Erysipelas of back and shoulder occurred. On thirty-sixth day wound entirely healed. Empyema sinus finally closed in about ten months.

CASE XXXV. (Garber, *Journal American Medical Association*, June 26, 1897, p. 1223.) Date of operation, 1897. Female, aged twenty-one years. Ill two weeks. Pericarditis, caused by penetrating wound with steel crochet needle. Not tapped previously. Incision in fifth interspace, one and a half inches to the left of the sternum. Evacuated about one fluidounce of thick pus and also some puro-sanguinolent fluid. Irrigation with salt solution. Permanent drainage with gauze. After-treatment, twenty-four days. Recovered.

PURULENT PERICARDITIS FOLLOWING PNEUMONIA.

Pericardotomy; Drainage; Subsequent Empyema; Operation Followed by Erysipelas and Axillary Abscess; Recovery.

By F. C. SHATTUCK, M.D.,
BOSTON,
AND
CHARLES B. PORTER, M.D.,
BOSTON.

E. W. C., twenty-six years old—of good habits, family and previous history, and of rather slight build—came down suddenly, October 22, 1895, with general malaise. Physical examination was negative, and everything pointed to the diagnosis of influenza, except a white-cell count of 17,900. There was no rigor, only chilly sensations.

October 25th. The diagnosis of pneumonia was established by the development of consolidation at the right lower back, extending forward through the axilla into the right front in the next few days.

28th. A loud friction râle, accompanied with pain, appeared over the whole cardiac area. White-cells 26,400.

31st. Pericardial friction very faint, but no effusion could be detected.

November 2d. The pneumonia seemed to be clearing in a measure; pleural friction was heard in the left axilla; pericardial friction had disappeared.

6th. For the first time signs of notable pericardial effusion were detected, the heart sounds being faint and dulness extending half an inch to the left of the left nipple.

9th. Signs indicate a diminution in the amount of pericardial effusion. Fine crackling râles in left axilla.

14*th*. Pericardical effusion has increased again. Dulness one and one-half to two inches beyond left nipple.

18*th*. Nausea and vomiting rendered rectal feeding necessary. Paradoxical pulse. White count 12,950.

22*d*. Paradoxical pulse very marked. Condition critical. On consultation with Dr. E. G. Cutler, the pericardium was aspirated in the fifth intercostal space, about one and one-half inches to the left of the left nipple, and 16 ounces of sero-purulent fluid were removed—specific gravity 1.021, albumin ¼ per cent., cultures show pneumococci. The pulse and stomach showed marked improvement after the aspiration. The reason for tapping in the above place will be set forth in a paper soon to be published.[1]

23*d*. Pulse irregular and weak; temperature steadily rising the last few days; respiration irregular, with a suggestion of the Cheyne-Stokes type; dyspnea in the irregular attacks; slightly delirious.

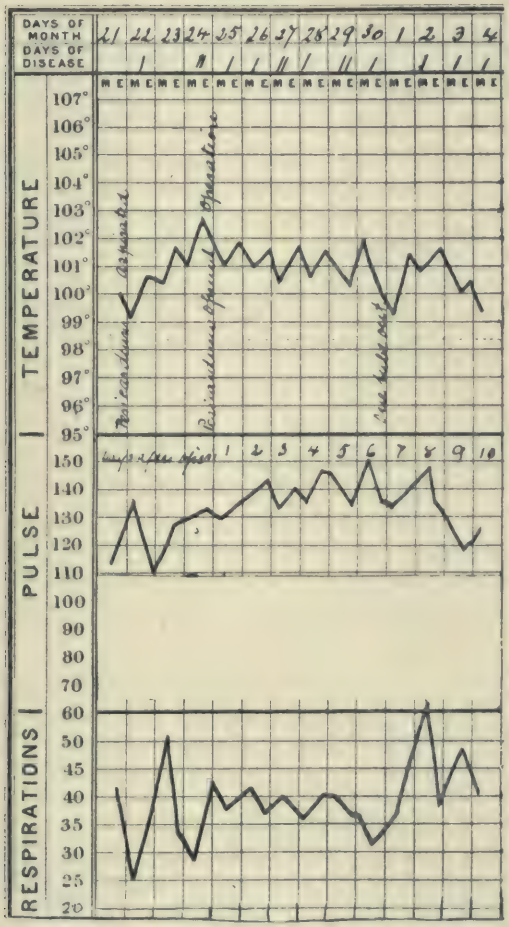
24*th*. The pericardial effusion was again fully as large as before the aspiration, and it was evident that nothing but incision and free discharge of the sac could save the patient; and, upon consultation with Dr. C. B. Porter, operation was decided upon and immediately performed by him.

At the consultation it was decided to approach the pericardium at the point where aspiration had previously been done. A curved incision was made, exposing the fifth interspace at the left of the sternum. Incision carried down between ribs, and pleura was opened one and one-half inches to the left of the sternum, in the fifth interspace. The aspirating needle was introduced through the first opening, and purulent serum escaped under considerable tension. Pericardium seized with forceps and opened. A stream of purulent fluid gushed out, spurting twelve to eighteen inches above patient, especially on any expiratory effort. The effect on the pulse was a striking improvement (observed by Dr. M. H. Richardson) in quality, tension, and volume. Amount of fluid estimated at about one quart. Pericardium douched out with sterile salt solution, and two soft-rubber tubes put into pericardium, which was first secured by four silkworm-gut sutures that passed through muscles, and two carried through the skin. Absorbent dressing. Enema: brandy, one ounce; coffee, three ounces; digitalis, twenty minims. Pulse greatly improved after oper-

[1] Transactions of Association of American Physicians, 1897, p. 185; Boston Medical and Surgical Journal, July 8, 1897.

ation, but no immediate effect on respiration was noted. Dressing changed after eight hours, a large amount of discharge, soaking dressing (not foul). Fluid from pericardium contains fibrin flakes. Cultures

CHART I.



Pericarditis. Pericardium aspirated on twenty-second day.

show pneumococci. Pulse after coming out of ether 130. Sleeps four to five hours with one-eighth of a grain of morphia. Breathing easier. Pneumothorax present. Tympany at top of left chest, with absence of respiration. Supplementary respiration right lung.

Liquids, two ounces every hour; oxygen, every twenty minutes for three hours.

25*th*. Large amount of discharge during night, saturating a large dressing. Siphon tubes arranged to collect discharge. The to-and-fro suction of air, apparently into pleura, has ceased, and tissue is close around tubes.

26*th*. Tubes work well. Amount of thick pus collected from them eight ounces. Pericardinm was washed out with normal salt solution. The tube out of which the pus does not drain was selected as the one through which to put the salt solution. The outflow was immediate through the other tube. The amount injected was measured and compared with the amount coming out, thus any danger of distending the pericardium was obviated. Washings very thick. Do not disturb patient.

27*th*. Washed out this morning, condition better. Not as stupid. Pulse better. Taking liquids, forty to sixty ounces daily. Brandy, twelve to fifteen ounces. Somnolent. Perspiring freely about face and neck. Vomited twice. Wound about tubes tight. Pneumothorax less. Respiration heard fairly over left apex, with some râles. Loud pericardial friction. Respiration easier, 40. Pulse 140, fair, irregular.

28*th*. Washed out this day at 10 A.M., 8 P.M., and 12 P.M. An attack of dyspnœa in the afternoon. Amount of pus collected in the last twenty-four hours, two ounces and one drachm. Washings contain many shreds and are rather thick, although they clear much more quickly than when washings were started. Nutritives omitted. Strychnia, one-fortieth of a grain every four hours.

29*th*. Air leaks in around tubes and destroys siphonage. Washed out at 9 A.M and 3 P.M. A large number of flakes washed out. Washed in through both tubes to-day. Washings come clear very quickly. Has drained very little since morning.

30*th*. Washed out three times. Washings quite clear, few flakes. Tubes removed, and larger one shortened one-third and replaced. Heart's impulse can be felt with tube. Slight discharge on dressing. General condition of patient much better. Respiration irregular. Dyspnœa, with tossing about of head. Sleeps in naps. Delirious at times. Takes liquids, sixty to eighty ounces, and brandy fifteen ounces in twenty-four hours. Pneumothorax increasing, no respiration at left apex. Heart dulness not distinguishable. Some abdominal distention, relieved by enema.

December 1st. Tube shortened. Discharge slight. Pericardium washed out t. i. d. with salt solution at 110° F. Feels better after dressing.

2*d.* Respiration and pulse the same. Restless, muttering delirium. Sleeps poor in naps. Liquids, fifty ounces in twenty-four hours, with toast and eggs. Brandy, ten ounces. Lungs almost flat over whole left back. Respiration relatively diminished, also fremitus. Right lung, supplementary respiration, some bronchitis. Pericardial friction over heart area. Metallic tinkling heard at left apex. Air sucked in and out of chest through wound.

3*d.* Washings clearer. Slight discharge.

4*th.* More delirious. Occasional Cheyne-Stokes respiration. Semi-comatose at times. At 2 A.M., one-eighth of a grain of morphia. This morning had an attack of acute collapse. Pulse weak, irregular, hardly perceptible. Patient cyanosed, skin clammy. One ounce of brandy subcutaneously. Digitalis, twenty minims. Oxygen, heaters. Slowly rallied. At 10 A.M., fifteen minims of digitalis subcutaneously. Chest: left side flat, with diminished fremitus and respiratory sounds. Aspirated in fifth and seventh spaces in back. Six ounces of yellow serum obtained with a specific gravity of 1020, albumin ½ per cent. Considerable pus in serum, but less than in pericardial fluid. Respiration a little easier since tapping. Stitches all out of wound. Small blind sinus sealed with rubber protective.

5*th.* Tube omitted. Opening into pericardium drained with gauze. Removed t. i. d. and cavity washed out. Eleven days after operation gauze substituted for rubber tubes. Sleeps quietly. Less delirium. Easier respiration. Pulse better. Looks better. Chest: pneumothorax, metallic tinkling, resonance fair, few râles at left apex. Left lung seems to be slowly expanding. Liquids, seventy ounces; brandy, ten ounces; toast, eggs, oysters.

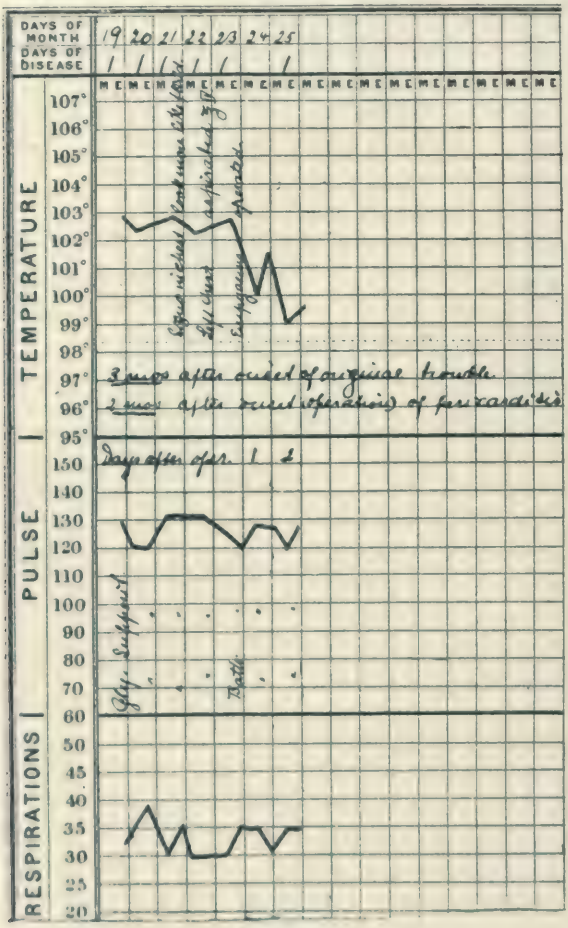
6*th.* Breathing easier. Pulse fair, paradoxical. No abdominal distention. Sleeps six to seven hours. Blood: whites, 22,400. Chest: respiration at left apex fair; metallic tinkling and pericardial friction.

8*th.* Very dull over whole left back. Fair respiration. Few râles. Slight bronchial respiration with increase of fremitus and vocal resonance. Respiration deficient at right apex.

Condition varying from time to time; but gradual improvement was noted up to December 20th, when the pericardium had closed. Only a superficial granulating wound on the twenty-sixth day after the operation. Much Cheyne-Stokes respiration when asleep.

Twitching of legs and face at times (strychnia?) Movable flatness in left chest. The presence of fluid was suspected.

CHART II.

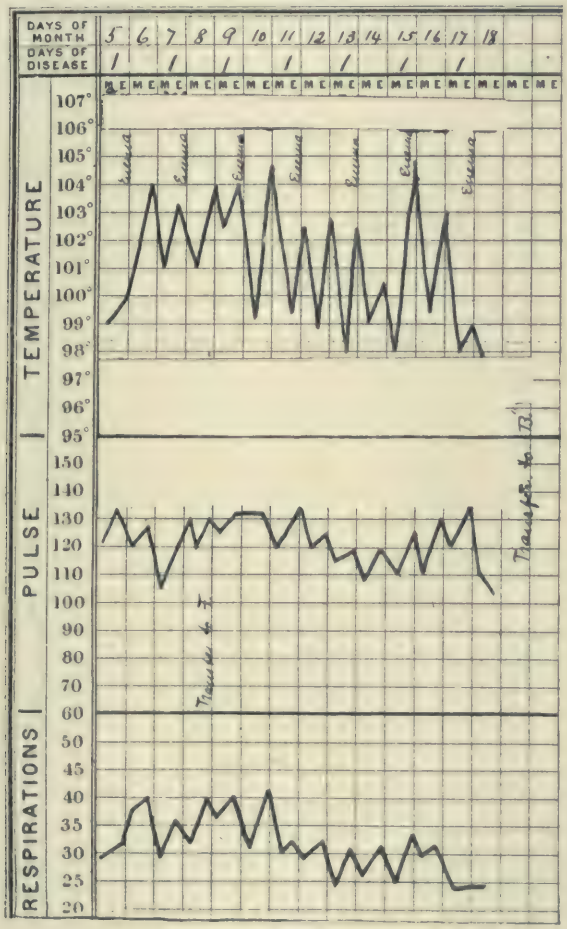

DAYS OF MONTH
DAYS OF DISEASE
19 20 21 22 23 24 25
TEMPERATURE
PULSE
RESPIRATIONS
107° 106° 105° 104° 103° 102° 101° 100° 99° 98° 97° 96° 95°
150 140 130 120 110 100 90 80 70 60
50 45 40 35 30 25 20
3 mos after ended of surgical trouble
2 mos after second operation of paracentesis
Days after oper. 1 2
Pulse
Rattle

Empyema.

30th. The wound had entirely healed, and patient was transferred to the medical side, to the care of Dr. F. C. Shattuck. For the next three weeks the temperature was irregular; and on January 23, 1896, the presence of pus in the left chest was demonstrated. Dr. Porter again operated, making an incison in the mid axillary line in the sixth

interspace. About a quart of pus escaped. The cavity was washed out with diluted liquor sodæ chlorinatæ, soda and boiled water, and rubber drainage-tubes introduced.

CHART III.



Erysipelas.

Six days later a resection of a portion of the fifth rib was found necessary to afford better drainage.

February 7th. Eighth day after the resection, at the upper and outer edge of the incision a small area, raised, congested, indurated and

slightly tender, appeared, which was pronounced by Dr. White to be eryspelas, and which gradually extended over the whole back of the neck and shoulder.

13*th*. The blood-count showed—reds, 3,500,000; whites, 19,500; hæmoglobin, 40 per cent. The pus from the chest showed few pneumococci and no streptococci.

19*th*. Twelve days after the resection, the erysipelatous eruption had disappeared.

One week later an inflamed gland appeared in the left axilla.

The sputum was examined, and no tubercle bacilli found.

March 10*th*. The axillary gland, which had suppurated, was opened and pus evacuated.

Gradual improvement took place in all respects until March 25th, seven and one-half weeks after the resection, he was dressed and up for half an hour.

Constant and steady improvement; healing of the axillary wound. The empyema opening remained as a long narrow sinus for many weeks, and finally closed seven months and three weeks after the operation for empyema.

A year after convalescence was established the patient was in excellent health and able to ride a bicycle a considerable distance without fatigue.

In considering the literature of purulent pericarditis treated by incision and drainage, we find that the first recovery was a case of Rosenstein's in 1881. Since then twenty-three more cases have been reported; of this number nine have recovered, fifteen died, and in one the result is unknown. The etiology of these cases is as follows:

	Recovered.	*Died.*	*Total.*
Anterior mediastinitis	...	1	1
Primary	1	2	3
Empyema	1	3	4
Trauma of chest-wall	1	...	1
Stab in pericardium	1	...	1
Pneumonia	1	1	2
Osteomyelitis	1	4	5
Pyæmia (following abscess)	1	1	2
Tubercular	...	1	1
Unknown	1	3	4
	8	16	24

As will be seen by the table, osteomyelitis appears as an important cause. One case followed a blow on the chest.

In one case pericarditis developed one month after a wound. Many of the cases were complicated with left empyema, and twice the pericarditis was discovered at operation while draining the empyema. Of the fatal cases, two died at operation; one lived two days; one, Delorme's case, lived eight weeks after the operation.

The organisms found in exudate were the staphylococcus aureus and streptococcus pyogenes, pneumococcus, and colon bacillus (in case of stab-wound).

The amount of pus evacuated varied from ten ounces to two quarts. In one (Dickenson's case), it was brownish and thin with arterial blood; in two (Körte's and Eiselberg's cases), foul and thick; in two (Newman's and Delorme's), thin. In the majority it was thick, creamy, without odor. In a number of cases, large fibrinous masses were found, the pericardium being covered with thick layers of lymph. An autopsy in one fatal case (Pepper's), the whole sac was full of a thick mass of fibrin as large as the fist; the drainage had been good, and the heart probably failed from pressure of these fibrinous clots. The shortest case of healing of the sinus after drainage was nineteen days, the longest two months.

Preliminary aspiration was done in all cases before opening the pericardium. In a number of cases paracentesis was done more than once, with and without injection of carbolic acid; and incision was finally resorted to owing to the rapidity of the reaccumulation. The immediate relief to pulse and respiration was almost always striking.

With regard to the indications for the operation, we may affirm with confidence that the percentage of recovery after its performance warrants the statement that it is indicated in all cases of purulent pericarditis, and perhaps in serous pericarditis, in cases where aspiration once or twice repeated is followed by reaccumulation of the fluid.

The Surgical Anatomy of the Pericardium.

All authorities agree as to the great variations in the line of reflection of the pleura and pericardium.

Sick[1] found that in the adult, out of twenty-three cases the pleural reflection at the level of the fifth rib cartilage lay either at or within the left border of the sternum in seventeen; at the level of the sixth cartilage the pleural border had not gone beyond the sternal border in ten; at the level of the sternal articulation of the seventh cartilage it was in nine cases at the sternal border, or this cartilage was below its lower border. Twice it was less than one centimetre from the sternal border.

In twelve children Sick found at the level of the fifth rib cartilage the pleura was either within or just at the sternal border in eleven. At the level of the sixth cartilage the pleura had not left the sternal border eight times.

It will thus be seen that, according to Sick's careful observations, even at the fifth space the reflection of the pleura will often be behind the sternal border. Brooks (quoted by Quain) in four out of seven quite healthy cases, found the left pleural reflection entirely behind the sternum, and in one at the sternal border.

According to Luschka (quoted by Quain) the pleura normally diverges from the median line at the upper border of the fifth costal cartilage, so that at the level of the fifth cartilage it is one-fifth centimetre; at the sixth, two centimetres; and at the seventh, three and five-tenths centimetres, external to the left border of the sternum.

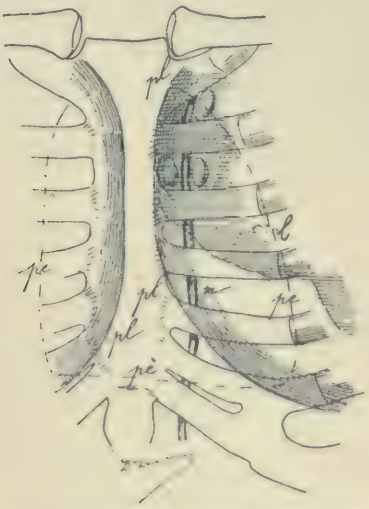
Delorme and Mignon[2] found in thirty-two adults that in the fourth interspace the left pleural border was within the border of the sternum in seventeen. At the level of the fifth cartilage it lay fifteen times internal to the sternal border, and seventeen times outside. In twelve cases at the fifth interspace the pleural border was at, or inside, the sternal; and in the sixth space the pleural border was outside the sternum in twenty-six cases, and at or within it in eight.

Dr. Thomas Dwight, Professor of Anatomy at Harvard University, agrees in the main with Sick's observations, but states that there are many variations, and that frequently it is possible

[1] Archiv. für Anatomie und Entwickelungsgeschichte, 1885, p. 342.

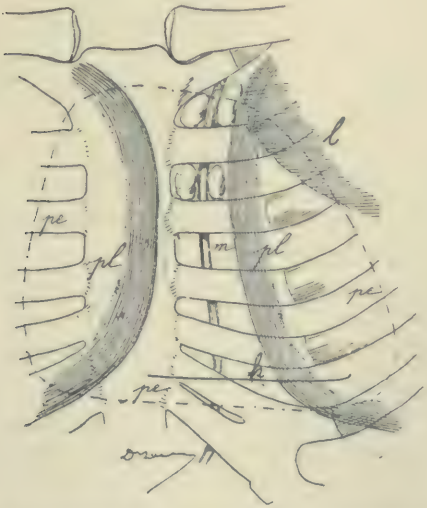
[2] Revue de Chirurgie, 1895, xv. p. 821.

FIG. 1.



Normal contour of pleura and pericardium (DELORME and MIGNON).
pl, pleura; *pe*, pericardium; *l*, border of lung.

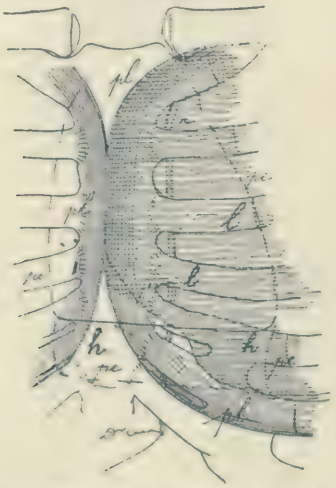
FIG. 2.



Line of pleura abnormally to left of sternum (DELORME and MIGNON).
pl, pleura; *pe*, pericardium; *l*, border of lung.

to reach the pericardium through the fifth intercostal space, and frequently not. Owing to the fact that the sixth intercostal space is small and narrow, and that even here the pleura often reaches the sternal border, he concurs with the writer in advising resection of the fifth costal cartilage, and if necessary the excision of a piece of the sternum opposite this cartilage.

FIG. 3.



Left pleura behind sternum, reaching beyond middle line.
pl, pleura; *pe*, pericardium; *l*, border of lung.

The internal mammary artery, according to Quain, runs parallel to the sternum at a distance from it of one centimetre. Delorme and Mignon, in thirty cases, found it a distance from the sternum of one-half to two centimetres, the distance averaging about the same in the first six interspaces.

In looking over the arrangement of the left pleura by Dwight, Delorme, Sick, Quain, and Testut, all agree that there is a varied arrangement. Below the fourth intercostal space in the majority there is a slight interspace close to the border of the sternum which is free from pleura. In twenty-two operations on the cadaver by myself it was found that the removal of the fifth intercostal cartilage, and the removal of half an inch of the

sternum opposite the sterno-costal joint, gave free access to the normal pericardium near its lowest level.

Three of the methods of operation which have been proposed and practised, namely, trephining the sternum (Riolan), approach through an intercostal space, and epigastric incision (Larrey) should all be discarded, as will be evident from the above account of the anatomy that in all of them there is danger of wounding the pleura or diaphragm.

Ideal Operation.

The following operation has been planned after careful consideration and experiment on the cadaver, in order as far as possible to meet the following indications:

1. To avoid opening the pleural cavity. This may be made more easy by adhesions as a result of tapping or inflammation.

2. To open the pericardium opposite the point where drainage will remain good after the sac has contracted.

3. To secure permanent and free drainage.

The steps of the operation are:

1. An incision from the middle of the sternum outward over the fifth costal cartilage to its junction with the rib.

The soft parts are cleaned from the cartilage with periosteum elevator, care being taken not to wound the pleura on the under surface. The cartilage is divided with bone forceps from the rib and the sternum. The internal mammary artery and vein are thus exposed, ligated in two places, and divided between. The triangularis sterni is separated from the sternum and pushed to the left.

A little careful dissection with the director, in case fat is encountered, exposes the pericardium, which is normally much thicker than the pleura. An aspirating needle should now be introduced, if this has not been previously done, in order to corroborate the diagnosis. If confirmed, the knife should follow the needle. The incision in the pericardium is best made obliquely downward and outward, beginning close to the excised border of the sternum. The edges of the pericardium should be stitched to the soft parts.

Irrigation should always be employed, with the object of removing any masses of fibrin which may lie at the bottom of the cavity; and if there are many such masses, it should be continued until the fluid returns clear.[1] The fluid may be weak sublimate or carbolic solution, or salt solution, according to the preference of the operator. The fluid must be warm and must have free exit.[2] With this exception no harm has resulted from irrigation, which has been practised in more than half the cases.

Drainage is best provided by two rubber tubes, one long and reaching to the bottom of the sac for the inflow, and a short tube just entering the sac for the outflow. As the discharge diminishes, one tube may be removed, and finally gauze drainage inserted. Gauze drainage has proved adequate from the first, but where the fluid is thick or flocculent, tubes give the only adequate facilities for the subsequent daily irrigation.

The after-treatment must, of course, be directed to two ends: first, systemic treatment, consisting of forced feeding and free stimulation, to maintain the patient's strength; and second, the care of the wound and the maintenance of drainage. The wound should be irrigated daily, and the patient, if his strength is sufficient to allow it, turned on his stomach to afford drainage.

The following cases have been reported of recovery from purulent pericarditis treated by incision and drainage.

Rosenstein, in 1881, had the first reported case of recovery. A boy of ten had been sick at home for two weeks, with pain in epigastrium, dyspnœa and fever. On entrance there were signs of pericardial effusion. Aspirated twice in left fourth interspace, and a half-pint of pus evacuated. Finally an incision was made over fourth space close to sternum; careful dissection to pericardium; pleural cavity adherent; large amount of pus evacuated; two rubber drainage-tubes inserted. Closure of sinus in nineteen days, and ultimate perfect recovery.

Gussenbauer. Boy of thirteen, osteomyelitis of humerus and pleu-

[1] Cf. Delorme's case, in which at the autopsy two handfuls of fibrin were found in the pericardium.

[2] Cf. Parker's case of death on the table from the distention of the sac by irrigating fluid, which did not have free outflow.

risy. Dulness of precordium not noted. Opened in fifth interspace in anterior axillary line, expecting to evacuate an empyema. Found effusion in pleura, and after resecting rib discovered enlarged pericardium. This was opened after aspiration, and pus evacuated. Rubber drainage, irrigation with thymol, recovery.

Davidson. Boy of six. Left empyema. Incision, evacuation of ten ounces of pus. In ten days later high temperature, increased cardiac dulness. Incision in fourth left interspace, one inch from sternum. Several ounces of creamy pus, drainage. Perfect recovery in five weeks.

Dickinson.[1] Boy aged ten. Pyæmia from gluteal abscess. Left effusion into pleura and pyo-pericardium. Pleura aspirated nine times, and pericardium three times; finally, drainage in fifth interspace on right of sternum.

The operation was performed under ether, with a narrow-bladed knife thrust along a trocar to right of sternum. Pus, blood, and air escaped. Air probably sucked into pericardium by contraction of heart. Boy much better. No right pneumothorax; much discharge from the rubber tube; a gain in dyspnœa; tube stopped up; exchanged for a larger one, and under good drainage immediate improvement. Air always bubbling through the tube with action of heart. Boy on his face three times a day to better drain the back of sac.

In three weeks two to three ounces of pus daily were drained from pericardium. The pus was still sweet. Tube in. In one week more the tube was removed and an oil-silk wick was inserted. In another week all healed. No mention of irrigation.

West's case, 1883.[2] Boy, aged sixteen. Two months after an injury to chest there were signs and symptoms of effusion into pericardium.

Operation, *September 14th*. Paracentesis, fourth left intercostal space, just under nipple. Thirteen ounces of pus were obtained by aspiration, creamy, and without flocculi. One per cent. carbolic-acid solution was injected, and allowed to flow out.

17th. Again worse. Paracentesis in fifth interspace, left nipple line. Needle passed into enormous cavity, four and one-half inches without touching anything. Pus more flaky, and did not flow well.

Operations under chloroform. Narrow knife thrust along canula as

[1] Clinical Society Transactions, 1889, p. 48.
[2] Medico-Chirurgical Transactions, lxvi.

a guide. Two quarts of pus washed out with warm 1-per-cent. carbolic solution. Rubber drainage-tube, one-half inch in diameter inserted. Two ounces 1 : 40 carbolic solution left in cavity. Very free discharge of sweet pus. Next day a soft catheter was inserted instead of tube. Irrigation with weak carbolic solution.

19th to *21st*. Finger inserted, could just reach pericardial sac. Tube meanwhile washed with carbolic solution, 1 : 40.

25th. Tube removed, cleaned, and replaced after washing cavity with carbolic. Cavity holds one ounce.

27th. Cavity closing. Very little discharge.

October 13th. Tube shortened. On the *14th* it was removed; and on the *17th* the incision was closed.

The operation was done *September 14th*, and the wound closed *October 17th*. Ultimate perfect recovery in one month.

Eiselsberg. *October, 1893*. The patient was stabbed with a knife over the heart. The wound healed a month afterward. Fever, signs and symptoms of pericardial effusion.

January 20th. Trocar inserted in fourth interspace, and a quart of brownish, purulent fluid evacuated with great relief to symptoms.

February 2d. Thirteen days later. Evacuation in same manner of 900 grammes purulent fluid, with much less relief.

9th. Again 1000 grammes pus.

20th Incision made over fourth left rib cartilage; and after resection of rib the healthy pleura, with lungs moving in it, could be seen. This was pushed aside and held off with iodoform gauze; then came onto a thick white membrane, which was aspirated and found to contain pus. An incision, four centimetres long, was made, evacuating two quarts of pus. This sac was then irrigated with warm salicylic-acid solution. The pericardium was sewed to the muscles and two drainage-tubes inserted. The pus contained large fibrin masses. The heart could be easily felt with the finger, beating powerfully.

During the first eight days daily dressing was necessary, and irrigation was attended by escape of flocculi of fibrin. On the second day iodoform injections were made through drainage-tubes.

On the seventeenth day both tubes were removed; they had already been shortened. In four weeks more the wound entirely healed.

The colon bacillus was found in the fluid. It is a question whether it was on the original knife, got in later, or came through the blood. Eiselsberg believes in drainage if rapid reaccumulations occur after

tapping, and speaks of the advantages of seeing where puncture goes, and thus avoiding injury to the heart.

William H. Betham Robinson.[1] Male, age sixteen. Complained of sore-throat, and on the following day developed diaphragmatic pleurisy on the right side. Six days later an unmistakable pericardial rub. The area of cardiac dulness increased much upward and to the mid-axillary line laterally. About two weeks from date of pericardial involvement, the aspirator was introduced in sixth interspace just behind anterior axillary line. A small amount of pus obtained. Next day a piece of the sixth rib was resected, and left pleura opened. Lung fixed by recent adhesions. Pericardium incised, and pus washed out freely—over two quarts. No irrigation, owing to patient's feeble condition. Drainage-tube introdueed, stitched to margin of wound. Tube removed on the sixty-first day after operation, and wound soon healed. At no time was there pus in the left pleura. Patient recovered fair strength. Can walk ten miles, but not equal to active exercise.

The following fatal cases have been collected:

Parker.[2] Case of osteomyelitis of both tibiæ, later development of pericardial effusion, fever. Aspiration in fourth left intercostal space. Eight ounces sweet, flocculent pus. Marked improvement. In four days returns of effusion. A. C. E. mixture. Incision, two inches long, by left sternal border, centre opposite fourth interspace. One inch of fifth cartilage removed. On cutting through perichondrium, distended pericardium presented; this was sewed to chest-wall and opened; much membranous pus and large flocculi of fibrin escaped. Irrigation with warm carbolic. Suddenly heart stopped beating, and patient died. Examination showed the sac distended with irrigation fluid, which had no proper escape.

Post-mortem. Lungs not collapsed. Pericardium much thickened, covered with large curds of pus and layers of lymph.

Bronner.[3] Girl of eleven. During an influenza epidemic had first pneumonia of right base followed by another consolidation in left apex. In two weeks right empyema developed. A pint and a half of sweet pus was evacuated by incision. Pulse and respiration still remained high, though temperature was normal—pulse 145, respiration

[1] Lancet, November 21, 1896, p. 1460.
[2] Clinical Society Reports, 1889, p. 60.
[3] British Medical Journal, February 14, 1891.

45. Finally signs of pericardial effusion appeared. Aspiration in fourth left intercostal space, one inch from sternum; pus appeared; incision carried down to pericardium. A quart of pus evacuated; rubber drainage inserted. Great relief after operation.

Temperature and respiration soon rose, in spite of free drainage and daily irrigation with boric acid. No harm resulted at all from these irrigations. Child gradually lost strength, and finally died, three weeks after operation. No autopsy allowed. Pericardial sac was felt to be full of granulations and not obliterated.

W. A. Edwards.[1] In a child of six, symptoms of anterior mediastinitis, later of pericarditis. Aspiration of pericardium showed presence of pus. Drainage with rubber tube after incision in fifth interspace and evacuation of eight ounces of pus. Later left empyema. Sixteen ounces of pus evacuated. Finally, resection of ribs was done, and death followed. At the autopsy it was found that the pericardium was almost universally adherent to the heart, with here and there the intervention of fibrinous masses.

F. J. Newman.[2] Man, age thirty-two, having been sick for three weeks. Symptoms were typhoidal until the week after admission to the hospital, when signs of symptoms of purulent pericarditis developed. Aspiration in sixth interspace withdrew eight ounces of thin pus. Marked relief from profound collapse. In two days aspiration again in fourth right interspace, and 46 ounces of pus obtained. On three other occasions about the same amount was withdrawn at intervals of a few days. Finally, a silver canula was thrust into the pericardial sac. Permanent drainage for two days, with irrigation with carbolic, 1–40. Then incision of sac with bistoury, and large drainage-tube inserted. Profuse discharge. Gradual and steady improvement to convalescence, when chills and bloody expectoration began, and in a few days death occurred. At autopsy there was found empyema on one side, pleurisy on the other; the pericardium much thickened (not ulcerated); some fibrin; sinus from pericardium was found advancing toward the second intercostal space; much inflammation of anterior mediastinum.

Savory. Boy with pyæmia, after large abscess of the shoulder. Left empyema developed later. Twice aspirated. Finally an incision in the mammary line, fifth left interspace drained pus from localized

[1] International Medical Magazine, 1893, p. 405.
[2] Australian Medical Journal, 1885, p. 303.

empyema and revealed a much distended pericardium. This was opened and 24 ounces of creamy pus evacuated. Drainage and irrigation through catheter; profuse discharge. Child died at end of fifteen days. At autopsy lymph and adhesions were found walling off pleural cavity; parietal pericardium much thickened; good drainage of sac.

William Pepper. Young man of nineteen. Influenza; joint pains; temperature 104.2°; enlarged pericardium. After aspiration drainage by rubber tube in fifth left space; profuse discharge of pus. Lived two days. At autopsy a little pus was found in pericardium, but the whole sac was greatly distended with very large masses of fibrin. Regrets not making much larger incision.

Osler. Halsted. Purulent pericarditis after acute necrosis of bones of nose. Incision in fifth space. Drainage with gauze wick. Excellent drainage up to death in sixteen days,

Mr. Howard Marsh[1] reported a case of suppurative pericarditis. Male, age fourteen. Admitted to hospital in very exhausted condition. Incision made just below nipple, through an intercostal space. Pericardium bulged forward. Patient died on fourth day. No drainage-tube. Amount of fluid in sac not stated. No irrigation.

Körte. Child of seven. Osteomyelitis of tibia, pyæmia, with staphylococcus aureus. Large area of pericardial dulness; pulse 160; cyanosis. Aspiration in fifth left intercostal space; purulent fluid containing aureus. Resection of fifth rib for two inches from sternum. On opening pericardium a quart of offensive pus was evacuated. Pericardium was covered with an abundant coating of lymph. Irrigation had no bad effect on the heart, which improved after drainage. Abundant discharge for a number of days. Child died on twelfth day. At autopsy the pericardium contained considerable pus posteriorly, with purulent infiltration of myocardium and posterior papillary muscle. As there were also purulent foci in kidneys, an abscess of the heart wall was thought to have ruptured into the pericardium.

Davidson. Boy of six. Pyæmia, after necrosis of third metatarsal bone; pleurisy; wandering pneumonia. Signs of enlarged pericardium, which was aspirated and opened in fifth interspace. Eight ounces of sweet pus were evacuated. A rubber tube, three and a half inches long, was inserted. No irrigation. Patient gradually failed, and died on seventh day. At autopsy a small amount of sero-

[1] Lancet, Nov. 21, 1896.

purulent fluid in each pleura; heart covered with lymph; drainage good.

Dr. O'Carroll[1] gives an account of a case of suppurative pericarditis secondary to pneumonia, which had been treated by free and constant drainage. The pericardial cavity contained less and less pus, but the patient died from asthenia two months afterward. The walls of the pericardial cavity were found to be adherent everywhere but in front, where there was about a drachm of pus. The puncture was made in the fourth space, a thumb's breadth internal to the line of the nipple.

Partzensky.[2] Case of serous pericarditis of unknown etiology in a male twenty-three of age. At the end of the third month of the disease paracentesis was performed and a litre of brownish serous fluid withdrawn. Eleven days later it was necessary to perform paracentesis again, and 100 grammes of pus were evacuated. On the following day an incision into the pericardium was made through the fourth intercostal space, much pus evacuated, and two drainage-tubes introduced. Lavage with a 3 per cent. solution of salicylic acid. Death thirty hours after the operation. Autopsy: 100 grammes of pus in pericardium, fatty degeneration of myocardium, double adhesive pleurisy, and hypertrophy of the right side of the heart.

Klefberg.[3] A sailor, aged nineteen years, had an enormous purulent pericardial effusion following influenza. Puncture and aspiration of 150 grammas of pus. Great cyanosis. Pulse could not be counted. Incision in fourth intercostal space under local anæsthesia. More than one litre of pus evacuated. Death on the sixth day. Autopsy: pericardium empty, but pus in right ankle-joint and right sterno-clavicular joint.

Sievers.[4] A woman, twenty-two years old, had purulent pericarditis following a right sided empyema. Paracentesis showed a sero-purulent fluid; and two days later an incision in the third intercostal space opened the pleura and then the pericardium. Sero-purulent fluid, drainage. Improvement in pulse and general condition. Four days later empyema developed on the left, and pleurotomy was performed. Death occurred six days after opening the pericardium, and

[1] Lancet, May 23, 1896.

[2] Gaz. med. Ital. Lombard., 1883, No. 11, p. 115. Virchow and Hirsch, Jahresbericht über die Fortschritto d. ges. Med., 1883, II S., p. 145.

[3] Tidskrift i Militär Helsovord, 17 Arg., 1892, Stockholm.

[4] Zeitschrift für klin. Medicin, xxiii. p. 26.

a not inconsiderable amount of purulent fluid was found in the pericardial sac. Double purulent pleurisy was also found.

Delorme and Mignon. Two cases.

The first was a male, nineteen years old. A case of empyema following influenza, operated on by Delorme, was followed by pericarditis three days after the operation. The pericardium was opened in the fourth intercostal space by the same operator after a surperficial examination, which was all that the moribund condition of the patient would allow. Only a few drops of fluid escaped, and the patient died in a few minutes. The autopsy showed the heart adherent to the whole anterior surface of the pericardium, except at its lower part; 500 grammes of sero-purulent fluid were collected in the lower and back part of the pericardium, together with a double handful of flakes of fibrin. If the incision had been carried further downward and to the left, this fluid would have been reached. Paracentesis, as ordinarily performed would have wounded the adherent heart.

The second case was a male, twenty-two years old. Tubercular pericarditis and left pleurisy. Incision in the fourth intercostal space. Pleura was opened, and 250 grammes of serous fluid escaped. An incision being made through what was supposed to be the pericardium, and no fluid escaping, the latter was thought to be adherent to the heart, and operation was suspended. Death, eight weeks later, of tubercular meningitis. Autopsy showed heart adherent to anterior surface of pericardium, and a large amount of fluid distending the sac below and behind.

The following case is added to the list, although it is one of serous and not purulent pericarditis, as showing that incision may be of benefit where puncture has failed to permanently relieve.

Rullier.[1] Serous pericarditis. Tapped four times and then injected with iodine, but the effusion returned. The pericardium was incised in the fourth left intercostal space. Recovery was delayed by left broncho-pneumonia, but was finally complete.

[1] Arch. de Med. et de Pharm. Militaires, 1896, i. and ii.

Bibliography.

W. A. Edwards. International Medical Magazine, 1893, p. 405.
F. J. Newman. Australian Medical Journal, 1885, p. 303.
Parker. Clinical Society Reports, 1889, p. 60.
Bronner. British Medical Journal, February 14, 1891.
Körte. Berliner klinische Wochenschrift, February 1, 1892.
Davidson. British Medical Journal, 1891, p. 578.
Sievers. Zeitschrift für klinische Medecinische, 1893, xxiii. p. 26.
William Pepper. University Medical Magazine, February, 1894.
Osler and Halsted. University Medical Magazine, Philadelphia, 1893–94. vi. p. 248.
O'Carroll. Lancet, May 23, 1896.
Howard Marsh. Lancet, November 21, 1896, p. 1460.
Rosenstein. Berliner klinische Wochenschrift, 1881, p. 61.
Gussenbauer. Prager Medecinische Wochenschrift, 1884, No. 46.
Dickinson. Clinical Society's Transactions, 1889, p. 48.
West. Medico-Chirurgical Transactions, vol. lxvi. pp. 235–281.
Eiselsberg. October, 1893.
Robinson, H. B. Lancet, November 21, 1896, p. 1460.
Delorme and Mignon. Revue de Chirurgie, 1895, xv. p. 821.

DISCUSSION TO DR. ROBERTS' PAPER.

Dr. J. McFadden Gaston, of Atlanta, Georgia.

The proposition that pericardial effusions should be treated in the same manner as pleural effusions implies that an energetic medicinal treatment should be resorted to, preliminary to any kind of surgical interference. The trend of clinical observation upon the relative advantages in serous collections of the pleural cavity by medication and aspiration is favorable to the former, especially in view of the tendency of a repetition of the latter to develop pus. The discussion which has been progressing latterly among those most familiar with serous and purulent collections in the thorax, inclines to more vigorous measures of internal treatment before using any means of mechanical evacuation. The reasons for this are even more urgent in pericardial effusions than in pleural effusions.

I have stated elsewhere that the exact stage at which these affections pass from the domain of medicine to that of surgery is not well-defined, and there seems to be a tendency of late to revive the active use of medication rather than resort to strictly surgical measures. It is evident that surgical pathology embraces cases requiring the use of medication, as well as operative interference, and such medicinal means of relief come under the category of surgical resources in like manner as instrumental appliances. If the distinction is established upon the basis of functional and organic changes, recognizing the former as limiting the sphere of the physician and the latter that of the surgeon, no question need be raised as to the mode of treatment. It is demonstrated by clinical observation that diseased structures are more tolerant of surgical interference than when in their normal condition, and the pericardium, in this respect, is like other parts of the physical organization.

Under the second heading of the paper, it is set forth that suppurative pericarditis is rarely curable by paracentesis, thus keeping up the analogy with pleuritic accumulations. It may, therefore, be considered that aspiration is not applicable to purulent collections in the pericardium, and should be limited to serous effusions.

This brings us to the third division, setting forth that incision and drainage should be instituted as soon as the diagnosis is made. This operation is said to have been practised as early as 1801, by Romero;

and Gussenbauer has successfully evacuated pus from the pericardium after exposing the part by the resection of five ribs. (Ashhurst's *Surgery.*)

The essayist suggests that resection of the costal cartilages may be indicated to obtain access to the distended pericardium without injury to the pleura. But it would be unnecessary that resection be performed when a division at the sternal attachment would allow the cartilages to be raised so as to expose the field of operation.

Paracentesis Pericardii. Under this heading the *Supplement of the International Encyclopædia of Surgery* reports that West chronicled among seventy-nine cases of purulent pericarditis, one in which the trocar had pierced the right ventricle—causing death. "The immediate result of the operation in nearly every case was good, even if but a small quantity of fluid was removed, the mechanical interference with the heart's action being obviated by relief from pressure." The operation has been done in the fifth intercostal space one inch to the left of the sternum, and the aspirator was preferred for serous effusion, while a free incision is advised for purulent pericarditis. "The quantity removed may be very great," says Richard H. Harte, in the article above referred to, "and in Dr. West's successful case as much as two quarts were removed without any bad symptoms, or even faintness, but on the contrary, with immediate relief."

The Annual of Universal Medical Sciences, which has had my contributions on "Thoracic Surgery" for some years—1890, 1891, 1893, 1894, 1895, 1896—will be relied on for data which will be culled without more than giving credit to authors in these years, and to the compiler in years previously. A. L. Loomis and Charles E. Quinby, of New York, edited the article on "Diseases of the Heart" (*Ibid.*, vol. i. 1889). They give Foureur's case of primary purulent pericarditis in which bacteria were abundant in the pus but absent from the blood. The coccus was the common one of suppuration (streptococcus pyogenes), and inoculations of cultures caused abscesses in various parts of the animal, but not pericarditis. "Probably," they say, "injury of the pericardium would have again localized the poison upon that surface. An interesting feature of this case was that no other points of suppuration could be found and that the blood was free from the cocci." In the same article Doubleday's fifty-six cases, treated by aspiration, at the New York Hospital; Musser's case mistaken for pleuritis; and J. K. Love's case of pneumo-hydro-pericardium; and Hasebroek's case of chylo-pericardium, are all mentioned.

1890 (*Ibid.*). Ferrier recommends surgical interference: 1. When the exudation is dangerous owing to its abundance; in case pleural effusion also exists, the latter should be first evacuated. 2. When, if small in amount, it shows no tendency to subside, and from its chronic course exposes the heart to fatty degeneration. 3. When the effusion is purulent and might give rise to septic conditions. The statistics are better in proportion in the four cases treated by incision and free drainage.

In 1891, we have no cases reported.

1892 (*Ibid.*). Handford relates a case in which eleven ounces of coffee colored fluid were removed by aspiration from the pericardium, with relief followed by death. Shattuck, R. F. Beckam, S. S. Stoll, Davidson, Herman Bronner, and W. G. Scott, also record relief, and, generally, permanent recoveries from the same operation or incision.

In 1893 we have Körti's operation. Puncture was made in the fifth intercostal space. After resection of about two inches of the fifth rib the pericardium was opened, and about a litre (quart) of thin, purulent, heavy-smelling fluid was evacuated. On enlargement of the opening to the left, the cardiac movements could be plainly seen and the heart kept on acting steadily, showing distinctly the three separate movements. Operation occurred on December 8, 1891, and death on December 12th.

T. Churton, of Leeds, reported a case of hemorrhagic pericarditis, with serous effusion in right pleura, in which he performed aspiration of the pericardium thirteen times and paracentesis of pleura seven times. The patient lived over a year.

1894 (*Ibid.*). Wilson, of Nashville, Tenn., has practised, as he supposes for the second time, paracentesis of the pericardium, through the fifth *right* intercostal space. An ordinary aspirating-needle was used twice, with immediate relief of the severe symptoms.

The cases of West, referred to already, were culled in 1893—thirty-six of the cases recovered. These recoveries confirm the belief that the best point of puncture is the fifth intercostal space, an inch from the left border of sternum. R. Siewers, of Helsingsfors, is equally positive in his preference for this position, as he had four recoveries out of nine cases punctured in the region to the left of the sternum, but he considered the distance from it to be two centimetres. He used drainage but no irrigation in his successful cases.

1895 *Ibid.*). Only one case, paracentesis pericardii.

Gould's *Year Book* for 1897 contains the following: Delorme and

Mignon (*Boston Medical and Surgical Journal*, March 12, 1896) have devised a method for puncture and incision of the pericardium which they think far safer than that formerly employed. The operation for puncturing the pericardial sac is as follows: A very small skin-cut is made in the fifth left interspace, close to the sternal margin, and an aspirating-needle is introduced closely against the bone. The needle is kept first by the sternal edge, and then by the posterior surface of the sternum for a centimetre, and is then pushed directly downward and a little backward to a depth of several centimetres until liquid appears in the aspirator. To practice incision of the pericardium the surgeon finds the edge of the left pleura and pushes it outward. Two centimetres of the fifth and sixth cartilages are excised by means of gouge forceps, commencing at the edge of the sternum. The intercostal vessels of these spaces and the triangularis sterni are then pushed away with the fingers. The pericardium is distinctly visible at the bottom of the wound, being of a pearly-white color.

The favorable results of incision and drainage for suppurative pericarditis encourages a resort to this operative measure whenever the case has passed from the serous to the purulent stage. It is evident that pus is a secondary phase of the inflammatory process in the tissues of the pericardium which previously yields serum, and there is rarely, if ever, a collection of pus without a previous serous effusion as in pleuritis. The only means available for testing the character of the contents of the pericardium is the aspirator or the hypodermic syringe; and if the serum is found, of course it should be evacuated, and medication with such agents as have been found most efficacious in serous pleural effusions. But if a purulent collection is already present the case requires a resort to incision and drainage without any delay. Medication may be combined with favorable hygienic surroundings at the same time that an operation is undertaken, and there is every encouragement to expect good results from alteratives and tonics in these cases.

Dr. Dudley P. Allen, of Cleveland.

The paper of Dr. Roberts, together with the address of our President, who cited the advance made in surgery by Larrey, recalls to my mind an interesting case reported by that surgeon. He describes a case of a soldier having purulent pericarditis. In this case he made a free opening and drained, removing the fibrinous masses by inserting the finger into the pericardial sac. It also brings to my mind the case

of a child, aged ten years, on whom I operated in 1892. There was marked bulging over the pericardial area. A portion of the sixth rib was resected, and two quarts of flocculent pus were removed. Although the patient was very feeble at the time of the operation, he survived and made some improvement. As the heart could be seen distinctly at the time of dressing, various medical men were interested in following the case, and the little fellow repeatedly asked for a looking-glass in order that he might see his own heart beat. The patient was in such feeble condition, however, that he gradually sank from exhaustion, and died twenty days after the operation. It was evident that a timely operation would in all probability have saved his life.

Dr. G. R. Fowler, of Brooklyn.

I cannot permit to pass without protest the remark made by Dr. Roberts, that my statements made last year in the matter of the variableness of the point of reflection of the pleura upon the left side were incorrect. These statements were based upon the researches of Maurice, Letulle, and Sick, as stated in my paper. These investigations are the most complete with which I am familiar, and, unless contradicted by observations based upon an equally large or larger number of dissections, must remain as authoritative.

THE TECHNIQUE OF INTRACRANIAL SURGERY.

By LOUIS McLANE TIFFANY, M.D.,
BALTIMORE.

In the short paper which I have the honor to present to the Association, the subject, which is a more or less extensive one, has been divided into heads, which I take up seriatim:

The Difference Between Operations for Traumatic and Pathologic Causes. The two should be considered quite separately; indeed, comparison between them is almost impossible. In traumatic cases operation is undertaken as a matter of necessity, suddenly, perhaps with instruments not quite suitable, but certainly without delay, the condition of the patient not permitting it. There has been no previous preparation of the patient. His general condition is unknown. By this I mean the condition of his internal organs. No preparatory treatment is possible. The elements of sepsis are often present, not only upon the surface, but perhaps thrust into the tissues by the traumatism for which the operation is undertaken, and infection may have already occurred within the head. The condition of the kidneys may be mentioned, this being a matter of which the operator must be in ignorance; for, even though the urine be examined immediately after the injury and before the operation is undertaken—and this should always be done—yet, if the patient has been transported a certain distance in cold weather, or the skin surface has been largely uncovered, as is not unusual after an injury, albumin will generally be present, and, possibly also, casts may exist; and so an accurate knowledge of the condition of the kidneys is wanting. The details in operative work, also, are often obscure, landmarks obliterated both within and without the skull. Finally, the head is opened in traumatic work as circumstances permit or seem to

indicate. The head may have been already opened before the case is seen by the surgeon, and he is forced to do patch-work.

In operations for pathologic conditions, on the other hand, the reverse of what has been said exists. The proper time is chosen. All things are prepared, the proper light obtained, asepsis is secured; there is a due regard for both local and general cleanliness; not only has the condition of the internal organs been investigated, but they have been made to work, and work smoothly; a well and carefully considered operative procedure is carried through after careful study and consideration and all things necessary are at hand. The operation then is undertaken in the best way for the patient's welfare. It is proper, therefore, to draw a hard-and-fast line between the results of operations undertaken for traumatic and pathologic conditions; not that excellent work is impossible in traumatic cases, but the very fact of the patient's having been subject to injury may take out of the surgeon's power the ability to obtain certain conditions which are essential to success, and should exist, but may not—cleanliness, for instance.

Preparation of the Patient. It is not easy to clean a head, and it is still more difficult to prepare a portion of a head and operate so that cleanliness shall obtain. It is best, therefore, that the whole head should be prepared and cleaned. This applies to all cases, unless of a very minor character.

Traumatic Cases. The head is to be shaved and the skin cleaned with green soap, hot water, nail brush, and carefully scrubbed. The ears should be cleaned out and filled with sterile cotton. The eyes should be closed with pads of sterile cotton. The scrubbing should be done not only upon the surface, but, if a wound exist, it should be scrubbed likewise, and an effort made to get out any dirt which has been forced beneath the skin; punctured wounds should be laid open; tracks beneath the skin should be opened and scrubbed; the edges of irregularly bruised tissue may be trimmed away and a clean surface obtained. Where coal dust or grease has been forced beneath the surface, scrubbing with a nail brush and soap, and

washing with ether and alcohol, will often be sufficient to obtain a clean surface. Dirt ground into the surface or edges of broken bone can be scraped away or nibbled away with forceps so as to be gotten rid of. After cleansing the head for (traumatic) operations, a towel wrung out in corrosive sublimate solution or sterile water, perhaps, can be used as a cover for the prepared territory until instruments and other things are ready. In preparing a patient for an operation undertaken for some pathologic condition, not traumatic, of course, I have always prepared my patient a day before the operation, and then again just prior to operating, and I see no reason to depart from this habit. An alkaline solution, bicarbonate of soda, I have found useful to remove dandruff from the scalp, but I generally use green soap. Shaving and scrubbing with green soap, or a poultice of green soap applied over the surface after shaving, and left on for an hour, followed by scrubbing, is efficacious. I remove the green-soap with alcohol and then ether, and then tie up in a corrosive sublimate solution until the following day; a repetition of the cleansing, as already described, gives me a clean surface upon which to operate.

The Best Way of Gaining Access to the Brain. As the brain is to be covered in after the operation, a large osteo-cutaneous flap, the base turned toward the bloodvessels, is probably the most effective way of uncovering the brain. It should be cut in one piece, and then broken at its base so as to permit of being turned down. This breaking at the base is much assisted by cutting across the bone with sharp forceps, or otherwise, and the flap should be cared for during operation, that the skin and bone are not torn asunder; it may be necessary to envelop it in a cloth wrung out in hot sterile salt solution. The cutting of the bone is to be done by the instrument with which the surgeon is most familiar—the trephine, rapidly revolving saw, chisel and mallet, all have their advocates. Jarring the head is probably the objection most frequently raised against the last-mentioned tools—the chisel and mallet. They are, however, the tools with which I am most familiar and which I prefer. Should the opening not be large enough in the skull, there should be no hesitation about cutting away the borders of the

opening until sufficiently large. For this purpose rongeur forceps seem to leave little to be desired.

There is a difference between the sides of the skull and the top, for bone need not be put back in the temporal fossa, since, thanks to the dense temporal fascia, there is not much sinking in. It is otherwise at the top and front of the skull, as bone there wanting, results in a deep depression. The time which is consumed in exposing the brain is largely the result of the bone-cutting. Twice it has been my fortune to operate upon heads where, at previous operations, bone had not been replaced. It was very easy to open these heads, and the operation was done with great rapidity. It is, therefore, a matter to be thought over and carefully considered, whether, when it becomes necessary to operate within the head, it may not be expedient to raise a large flap, remove the necessary bone, replace the flap and allow it to heal. A month or two afterward the surgeon will operate to remove the pathologic condition present, and can do so safely, bone not obstructing. The removal of a piece of cranium and replacement of the skin flap are accompanied by so little danger that this plan offers advantages, especially so when the prolonged bone-cutting which is necessitated by an intact cranium is to be followed by a long piece of intracranial surgery.

It is worth while remembering that opening the skull, even in incurable cases, may diminish pain and optic neuritis.

The dura is to be divided and turned aside as a flap, the line of division being about one-third of an inch internal to the bone section, so as to permit of suturing and replacement. Generally speaking, the dura is to be respected and treated as are other serous membranes—the peritoneum for instance—and with no more consideration.

Arrest of Hemorrhage. From the skin, hæmostatic forceps have sufficed in my hands to arrest hemorrhage. I can imagine that with a transverse bar at the top, T-shaped blade, a larger area of skin would be pressed upon, and so bleeding better arrested; perhaps the T-shaped blade could be covered with rubber with advantage. By encircling the cranium with a rubber band I have not had satisfactory results. Hemorrhage

from the bone during the cutting may be arrested by Horsley's putty, or pressure with dry gauze. By crushing in the edges of the bone with heavy forceps, bleeding from the diploë can always be arrested. From the dura, a curved needle, carrying a fine thread, passed around the artery and tied, has sufficed to stop bleeding. From veins, the same may be said. Where hemorrhage comes from the sinus I have arrested bleeding in several ways: by suturing the wound in the vessel with a curved needle; passing the thread around it and tying it; also by gauze pressure; these methods have been sufficient in my hands. After turning the dura back and exposing the surface of the brain, vessels are to be sought for and tied very carefully, without dragging, by two threads and divided between. Forceps will generally tear off, and should not be employed, save very temporarily. It might be that serres-fines would be of use.

It is worth while to call attention to the fact that tumors within the brain will push up sulci from below, so that vessels can be tied more easily than in the normal brain. A growth should be encircled by ligatures under these circumstances. The material used in ligating will be at the surgeon's pleasure. I use very fine sterile silk. Finally, there is that form of hemorrhage which may come from the exposed surface, after removal of a growth, and is usually denominated parenchymatous. I have found nothing so effectual in arresting this as pressure with gauze. It may be that the gauze can be taken away at the end of the operation; usually, however, it is to be left protruding, and removed in two or three days. In a recent case under my care the gush of blood after the removal of the tumor was enormous, yet ceased promptly on packing.

In regard to the anæsthetic, special indications for one or the other anæsthetic lacking, I have used chloroform, intracranial congestion being probably lessened thereby. It is a well-known fact that under ether the face becomes congested; it is reasonable to presume that a similar condition may obtain within the skull. In a recent case I commenced anæsthesia with ether. The face became much swollen, especially at the angle of the eye, so I changed to chloroform during the course of the operation, and the venous turgescence entirely disappeared. This

change of anæsthetic I have resorted to several times while actually operating.

The Recognition of the Brain Area Presenting. This has to do, of course, with cerebral topography, and it is scarcely necessary here to speak more fully on this subject. I have not hesitated in intracranial work to have at hand a cast of the brain, in order that I might compare it with the exposed area, and I see no reason to doubt that it is a good plan. Electrical stimulation of the exposed area by the methods at present in vogue gives most efficient aid to the operator.

When operating for a tumor of the brain which is covered by the cortex, the color and consistency of the exposed area may give information, but an incision will probably be of advantage. Certain growths have the same consistency as the brain, and have been traversed by needles without recognition; hence, color and consistency failing to be recognized, probably an incision into the brain is best; possibly touch followed by incision, if the tumor does not present, is a far better way than touch followed by puncture, unless a cyst is recognized as present.

Removal of Intracranial Structures. Of a tumor it is scarcely necessary to speak, but the removal of the cortex is a matter about which much can be said. Undoubtedly, in many cases of tumor the cortex is greatly displaced; but it is also probable that where the cortex is removed restoration of function, to a certain extent, at all events, will follow. Circumscribed growths, of course, may be taken away by spoon, finger, knife, etc.; but infiltrated growths, while they may be taken away so far as can be recognized by the operator, give most unsatisfactory ultimate results, recurrence being the rule. The dura being removed should be, in my opinion, replaced by gold foil, which in my hands has been efficient to prevent adhesions between brain and scalp.

Closure of the Wound and Dressings. Intracranial sutures of silk I have used with advantage. To obtain a bone flap, where it is thought necessary, when the natural bone is wanting, different expedients have been made use of: thus the periosteum from the tibia has been transferred to the head; the

outer table of the skull, while connected with the skin, has been fashioned as a flap to turn over and cover the defect; the removed bone, perforated with holes so as to permit of drainage, has been used, etc. For the skin I use always subcutaneous suture of silkworm-gut, and I see no reason to be dissatisfied with it. A voluminous dressing of sterile absorbent gauze has done all that is necessary. I have not closed completely a head opened for an extensive operation, save in one or two instances, and here I have had occasion to regret my method. I drain by means of a piece of silver wire hooked in the lower angle of the wound, and believe that my patient's condition will be improved thereby. The time when dressings are to be changed will vary with the condition of affairs present, and is to be done with the same care and regard for cleanliness as was the primary operation.

DISCUSSION.

Dr. W. W. Keen, of Philadelphia.

In my opinion the disinfection is very important. Two years ago I saw some intracranial operations abroad, in which no disinfection was done until the moment of the operation. Not only was this true of these operations, but also of many cases of abdominal surgery. These cases were handled and examined by members of the class, and then disinfection was done. Only partial shaving was done in the case of operations on the head. I do not know how these cases did afterward, but apparently this method was a common practice, although I do not think it is the best method. I prefer to disinfect the day before, and again just before operating, as I believe it is safer and the results are better.

In operations on the skull, the size of the opening depends on what you want to do. In many cases, as, for example, puncturing the lateral ventricle, a small opening will suffice, and in many cases of abscess of the brain a small trephine opening is sufficient, while in cases of large tumors of the brain, large flaps are necessary. As a general rule, I have rather settled down to the use of Pyle's chisels, as I think they are better than any others. By this means I have been able to remove nearly one-quarter of the skull. For my own part, I prefer to make my opening large, in order that we may be able to see the brain and to know what convolutions we have to deal with. I have not yet done anything like so extensive an operation as that of Doyen. He takes the ground that cerebral localization is a matter of the past, and is no longer a necessity to the surgeon. I have not used the dental engine excepting in two or three cases where I have had dentists use it. I believe it is a very good instrument, and I think Cryer's is the best. Not using it every day, I am not accustomed to it, and am, therefore, not expert in its use. In one case, though I was using it with the greatest care, the small trephine suddenly went through, and penetrated the cerebral substance. Although the opening of the skull by means of the chisel does take a long time, still I am afraid, as a rule, to trust dentists to do this, because they are not trained in aseptic surgery. In one of my own cases infection took place behind my back by a man who had done a good many of these operations. It was noticed by the class, and my attention was afterward called to it. I have, therefore, practi-

cally abandoned the use of the machine, because I cannot use it myself with dexterity. One great objection to the use of the chisel which we may occasionally meet with is a very thick skull, but as yet in using the chisel it has not been my misfortune to meet with such a case. I should deplore it very much, as it is then an operation of excessive danger and excessive difficulty. I remember one case in which I fortunately used the trephine, in which the skull was over one-half an inch thick. The result would have been unfavorable, probably, if an osteoplastic operation had been done.

I have replaced as many as fifteen trephine buttons one and one-half inches in diameter. Up to the present I have never had any disaster. I was present at an operation in which such a replacement was done by another surgeon. No care was bestowed on the button to keep it warm or living or to prevent its becoming infected. It practically became a foreign body, and I had to remove it later. If there is to be any replacement the button must receive the most scrupulous care Recently I trephined a boy, removing on each side of the forehead a button one and one-half inches in diameter, using a ⊥-shaped incision. I kept the buttons in a bichloride solution of 1 : 2000, in a cup which was placed in a basin of hot water. In this I placed a thermometer and detailed one nurse to watch it, keeping it at a temperature of from 100° to 105°. Several months later no deformity was observable by touch or sight.

When the bone is not replaced membrane fills up the aperture completely, and but little depression results. On the forehead any depression would be a decided objection, but on the side of the head it makes but little difference. A number of cases in which I have done secondary operations have shown that so far as protection is concerned, this membrane is very thick, and except against pointed instruments would be a complete protection for the brain.

In respect to the mode of closing the opening I should like to say a word about two methods I have adopted with advantage. First. The method which I suggested some years ago of filling any gap in the dura. I have now employed this method four times, in each instance with the best results. From the under surface of the scalp I have detached a sufficiently large piece of pericranium, with a considerable amount of the loose connective tissue by which it is attached to the scalp, and with this have filled up the gap in the dura. In three instances I have secured it in place by a few stitches; in one instance I simply laid a large piece in place without any stitches, and the result

was equally good. I have always turned the osteo-genetic surface upward, so that should any bony growth occur it would be away from the brain. In one case, in which accident had not only destroyed the dura, but destroyed the pericranium under the flap which I raised, in order to get a piece of pericranium I lifted a second flap alongside of the first, and having secured the pericranium replaced the flap. Such additional traumatism is so slight with modern surgery that one does not hesitate a minute about inflicting it, especially as it was in the hairy scalp and the scar would not show.

In filling the opening in the bone I would call attention to one method which I adopted recently, and which I liked very much. If there is a bony gap and the dura is intact, instead of chiselling the outer table underneath a flap of scalp and transplanting flap and bone together, I have raised the flap over not only the area of the aperture, but a very large area adjacent to it; have then with a gouge and mallet chiseled away a large number of pieces of the outer table of the adjacent bone, sufficient to fill in the bony defect, have placed them on the dura and then replaced the flap. They grew in place, and filled the opening excellently.

I was very glad to hear Dr. Tiffany make a new point in reference to operating in two stages, which should be separated, if possible, for two weeks, or even more. I do not mean that the limit of time should be necessarily that long, as many cases will not permit it, but I do think that a somewhat prolonged interval is far better than the brief one usually allowed. In case of removal of the Gasserian ganglion, where it is necessary to pack, the interval cannot be prolonged more than three or four days; but where a tumor is to be removed, it is far better that we should wait until healing takes place, say, ten or fourteen days. The reopening of any as yet unhealed wound is necessarily subject to the greatest danger of infection, no matter who the surgeon is or how careful he is. No man meddles with a very recent wound a second time without the possibility of infection and a fatal result. I thoroughly indorse Dr. Tiffany's view that a second operation should be delayed until the wound is entirely healed. This is practically not an operation in two stages, but two operations.

I have never yet met with permanent and complete paralysis after removal of any of the cerebral centres. While at first the paralysis is complete, it gradually subsides and usually disappears almost entirely. In one case, as yet unpublished, in which I removed the thumb centre,

the paralysis disappeared entirely within a few months, so that the two hands were exactly alike in strength.

The two great difficulties in cerebral surgery are the time necessary for opening the skull; and secondly, hemorrhage. The first is partly met by Dr. Tiffany's suggestion, but the second must be attended to at the time. I think hemorrhage is the most troublesome and dangerous of all the problems of intracranial surgery, although it is very rarely that I have had fatal results from it. Recently, in a case of an irremovable brain tumor, I did three operations on the same patient with the greatest benefit, for the purpose of relieving intracranial pressure. I was met in the second operation by a really appalling hemorrhage from the scalp alone. I thought the patient would die on the table. I never had hemorrhage equal to it; but finally by ligature, forceps, pressure, and hot water, I was able to arrest it. Fortunately the patient got well, and, with a great deal of misgiving, I attempted the third operation for the purpose of removing some of the tumor and relieving insufferable headache. During this operation I was not troubled at all by hemorrhage.

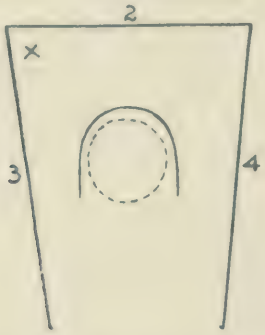
Hemorrhage from the bone is usually met by Horsley's antiseptic wax; or, if it be from the numerous small vessels between the dura and the bone, as in separating the temporo-sphenoidal lobe from the bone in removal of the Gasserian ganglion, temporary gauze packing stops it entirely. Hemorrhage from any of the sinuses can, as a rule, be met with gauze packing, which in my experience is dedidedly the best, or by forceps, or ligatures. Often when we interfere with the brain itself we can lift the pia and its vessels and work underneath them.

I should like also to call attention to one other fact, which I think is rather new in cerebral surgery, namely, that the lateral ventricles can be packed with gauze. In a case operated on a year ago for Dr. H. M. Thomas, of Baltimore (*American Journal of the Medical Sciences*, November, 1896) I removed a large tumor of the frontal lobe. When the tumor was removed I found the lateral ventricle widely open. Fearing that the blood and wound fluids which might accumulate in the large cavity left by the tumor would find their way from the lateral into the fourth ventricle, and would produce death by pressure on the respiratory centre, an accident which occurred in one of Horsley's cases, I packed the lateral ventricle with iodoform gauze for two days, and thus avoided such a fatal result in this case.

Dr. Robert F. Weir, of New York.

In all operations for intracranial surgery I have found that there are two points of immediate danger, of which the first is the continuous and often serious hemorrhage from the scalp, and the second is the time and accidents connected with the opening of the skull. I have tried a number of devices to control the bleeding from the scalp; and sometimes this is easy, but often it is difficult. I usually pass, where the flap will admit of it, a rubber band around the head tightly over pads in the temporal region; where this fails, I have found that if you will pass one or two moderate-sized hat pins through the base of the U-shaped flap and cross their ends with two or three rubber bands, the hemorrhage will be readily controlled. Other pins along the cut-edges of the unreflected scalp must be similarly applied. I sometimes employ clamps, and get along fairly well with them, but in not every case am I able to control the bleeding, as it will drip more or less all the time. The second important point—the method of opening of the skull: I confess that I have given up to a large extent the using of the chisel, excepting in a few instances and in the thin temporal

Fig. 1.



regions, for exploratory purposes and in doubtful cases and for the removal of tumors. I have discarded it for other reasons, of which I shall allude to in a moment, and in cases of thick skull I have abandoned it entirely. Even where the skull is not abnormally thick I have had a fatal result, justly attributed to the shock of the repeated blows of the hammer. With regard to osteoplastic operations, I seldom resort to them now, except in the Krause-Hartley neurectomies. My reason for this is that nowadays we open the skull mainly for

traumatisms and their sequelæ, often septic, and for abscesses and for tumors, conditions in which I do not wish to replace my bone-flap, as I prefer to have some relief there for immediate drainage or to meet then the possibility, nay, probability of recurrence of brain-pressure. I therefore prefer to make my provisional opening somewhat different, and of late years I have used the electric saw, or enlarge the first three-quarter inch trephine opening with the ronguer.

The diagram will illustrate the method I often use; it is a modification of Horsley's. Over the centre of the operative field a U-shaped incision is made through the scalp to the bone, and large enough when raised to admit a five-eighth or three-quarter inch trephine. Through the opening of the skull then made is passed a dura protector. (See Fig. 2.) This is a thin plate of metal slightly curved to accommodate itself to the convexity of the dura, which is attached to its handle by a shank that can be bent as wished

FIG. 2.

Dr. Weir's dura protector.

This is introduced through the cranial opening to the corner, and then the scalp at that place is divided to the length determined on, and the hemorrhage having been controlled by immediate pressure, the electric circular saw is immediately and boldly applied. The metal guard between the skull and dura can be immediately recognized if most lightly touched with the saw, and as the latter cuts its way along the intended line the guard is kept always beneath the saw; the length of the guard, at least three-quarters of an inch, fully protects the parts beneath. After the first bone-cut is made a second and third are similarly effected, and the necessary three sections can be made in less than five minutes. I have often completed the whole procedure of making the preliminary trephine opening and the three cuts in the skull and fracturing and laying back the osteoplastic flap thus formed in less than ten minutes. This plan I have resorted to since 1890, and I show you a sample of the section thus made in 1892, in a case where the skull was thus opened for epilepsy due to a large recurring cyst which had been treated previously by one of my colleagues by a small chisel-opening and drainage. I failed to remove

the whole cyst, owing to its size, depth, and free hemorrhage, and so I resorted to Estlander's heroic idea of removing this large piece of reflected bone, and thus allowing the scalp to drop as much as possible to the bottom of the cyst, which was again drained. No recurrence of the cyst has taken place; but little improvement in the epileptic seizures has resulted.

I seldom operate at the present time for epilepsy, and I have not much heart in operating for tumors of the brain, so often malignant or multiple, and, as for idiocy, I have come to a full stop. As just stated, I prefer to leave the skull open, being unclosed in most cases. In traumatic cases—*e.g.*, depressed fractures, and particularly in exposed parts of the skull, I have not hesitated to put in a celluloid plate to close the bony gap, either immediately or after the period of possible infection has passed. I have now two cases where such a plate has been worn for five years without any untoward results, and the skull opening remains solidly filled. Gold foil has been employed twice, but it is rather troublesome to work with, and it does not commend itself much to me, particularly as recent reports show that the granulations can penetrate the gold film.

Dr. John Parmenter, of Buffalo.

For opening the skull I prefer the gouge and hammer. I formerly used the chisel instead of the gouge, but the latter is preferable, as by its use the chief objection to the chisel, viz., cerebral commotion, is obviated. The advantages of this method over the trephine are speed and ability to make the opening where and of what shape you may wish. I have used the surgical engine and electric saw somewhat. The heat caused by the saw not infrequently causes necrosis unless the saw is kept cool with water. Where the diploë is vascular the blood will in a measure take the place of water. The dura may be incised according to the form of the opening, but where possible I like the crucial best.

To control hemorrhage I employ a modification of Dr. Weir's method, which consists in simply stitching back the large flap so as to produce a sharp angle at the junction of the flap with the scalp. The bleeding from the circumference of the opposing edge may be restrained by a running stitch, after the manner of a purse-string. Hemorrhage from the bone is ordinarily best controlled by crushing it with bone forceps. Meningeal vessels may be tied or twisted. When the sinuses are opened pressure with hæmostatic forceps or

lateral suture, where feasible, will usually control a hemorrhage at first sight alarming. In the event of these measures failing, gauze packing may be used. The use of styptic solutions is not, in my opinion, advisable. As to the recognition of the area of brain through a small opening, I must confess I am unable to determine with the eye exactly what part is presenting, and I resort to the electrical test, which, however, should be repeated as infrequently as possible, as otherwise it will yield negative results, the centres quickly losing their irritabillity when stimulated too much.

Palpation of intracranial growths should be done with the greatest care, if ever. I am sure I have seen one case of fatal shock follow the procedure where the entire finger almost was inserted between the dura and the cortex.

When the operation proper has been concluded I take time and use patience in checking hemorrhage, often utilizing this time by putting in my superficial sutures; then, when the oozing has all ceased, I close up the wound, usually completely, sometimes leaving a catgut strand or very narrow piece of green protective in the lower angle of the scalp and reaching to just within its inner surface. Even where dirt, cinders, etc., have been ground into the wound I have sheared away the soiled tissues and made complete closure of the wound, with perfect union and without after results. In a case seen within three months, where hair, glass, and other foreign material, together with a large fragment of the inner table had been imbedded in the cortex four days previously, I cleared out the wound, removing some two teaspoonfuls of cerebral matter, and made complete closure without drainage. Primary union resulted, and to date the man has remained entirely well.

In short, the surgeon who removes tissues so bruised as to easily necrose, who secures thorough hæmostasis, and who is careful to be aseptic, will need to use drainage less and less.

Dr. S. J. Mixter, of Boston.

I believe in cutting very extensive flaps. It is so frequently necessary in the course of operations on the skull to have to enlarge the opening, and I think it is better to have plenty of the skull exposed. In opening the skull the trephine is the instrument most used.

It seems to me there has been a great mistake made in the use of this instrument. I think it is a very clumsy one, and its diameter

should never be over three-quarters of an inch. The use of the chisel is especially convenient along the line of the squamous suture. A few blows of the chisel will usually open the skull sufficiently. It occurred to me that in doing the operation in two stages, why would it not be well to place between the skull and the skin a piece of celluloid to prevent adhesions. The question of stopping hemorrhages from the sinus is important, but you can always accomplish this by pressure. I have seen the lateral sinus opened a number of times, and have opened it myself three or four times purposely. I have used pressure, and have had no trouble when controlling the hemorrhage. As to the deeper sinuses, the question is more important. In an operation which I attempted last week for division of the fifth nerve behind the Gasserian ganglion, there was hemorrhage from the venous trunks, and, finally, not being able to get a good view of the nerve I divided the superior petrosal sinus. The patient died in two days, but I have not heard whether it was from hemorrhage or not. This sinus is difficult to pack, and it is hard to bring pressure to bear. An important question is how much pressure will the different parts of the brain stand? How much pressure and compression will it endure. In my fatal case the question was whether the fatal result was not due to pressure on the brain? In cases of hemorrhage we pack the brain to a very considerable extent; but the patients very often die, however, and it is important to know how much rapid compression the patient could endure. Another important point is how much laceration the brain can stand from exploration with the finger. There are a good many cases of inflammatory processes in the brain which are very different from the tumor cases. Frequently, in spite of the diagnosis of abscess of the brain having been made by good neurologists, I have cut down and found the condition was one of compression. At the point selected by neurologists there has been nothing found in any way resembling abscess. In cases of over-swelling of the brain you will often have hernia of the brain resulting, and the question arises, How much pressure can this hernia stand? These are all practical points that need to be decided. In exploration of the brain to determine the presence of the tumor it is of the greatest use to have a skilled pathologist at hand so as to decide from small fragments which you may remove, whether you have to deal with a new growth or not, which is sometimes a difficult thing to do. As to closing the wound with bone flaps, I think it is still an open question, how much good it does. I have often seen enormous losses of bone in cases.

REMOVAL OF THE GASSERIAN GANGLION.

By STEPHEN H. WEEKS, M.D.,
PORTLAND, MAINE.

History as given by the patient:

"I am a clergyman by profession and am now forty-five years of age. Ten years ago, while pastor in Kansas City, Mo., and in the midst of excessive and victorious labor, during the marvellous growth of that Western city, I was seized with neuralgia deep in my lower jaw on the left side of my face. Through the first year the pains were simply darting and never spasmodic.

"In the spring of 1888 I became pastor of St. Paul's Methodist Episcopal Church in Newark, N. J. Some months later the darting pain in the lower jaw, which had continued to that time, at night began to leap from the lower to the upper jaw, and after playing between the two for a while, at last became a spasm of pain, holding for a minute or two both jaws, and then letting go of both. After a half hour the same experience would be repeated, I being drawn out of bed to pace the floor to help bear the agony. This did not occur every night; I averaged about three months in a year with little or no trouble; the balance of the year the disease afflicted me in all its varied forms. My perfect health otherwise enabled me to bear up against it and continue full work. No medicine ever gave me relief, and I used no drug to help me bear the pain until very much later.

"In April, 1892, I was transferred to Brooklyn, N. Y., and assigned to Hanson Place Church, the largest church in membership of the denomination in this country. The work was glorious, inspiring, but tremendous. I had the good fortune to have my trouble treated for a year and a half by Dr. Topham, an excellent electrician of that city. Electricity is the only treatment that ever helped me, but after the time mentioned it became exhausted, and seemed to excite pain

rather than subdue it. After that my suffering increased and became unendurable. I abandoned work for a year, beginning with the spring of 1894. In September of that year the first operation under the left eye was performed by a surgeon in the hospital at Hartford, Conn. That operation never gave me much relief. Somewhat better the next spring, I accepted a call to Chestnut Street Methodist Episcopal Church in Portland, Maine. After two months I became much worse, but I preached through a whole year up to March. Keeping my brain stirred up mentally sometimes enabled me to get on top of the pain in my face, when to let nervous tension down and lie down for sleep would bring on worse suffering. I broke down completely in March, 1896, and my physician recommended another operation for the removal of the nerve in the lower jaw. On March 15th, 1896, the nerve of the lower jaw was removed. The second operation was followed by much better results than the first.

"I had twinges now and then up the stubs of the nerve in both jaws and back into my head, and yet for one whole year I did not have one spasm of pain. I took great hope and began to build up. It is well for me to say that organically I am absolutely a healthy man and always have been. I have never had any serious trouble in any part of my body save in the nervous part of the left side of my head. All last year I was in almost perfect health; I gained every week, lived out of doors, did pastoral work, rode my wheel, and grew in weight from 135 to 180 pounds.

"I knew of a possible third operation, for I had read the literature of my case quite carefully, and the twinges now and then reminded me of it. I was almost in perfect health on Saturday before the first Sunday in March, but on that Sunday while reading the sacramental ritual in my church I was seized with a spasm of pain in the old location almost as bad as any I have ever felt. I read through the service, and let nobody know, although all the power and will of my being were employed to keep me from breaking up the service. The next week was one of dreadful suffering, arrangements were promptly made for the third operation, and on the next Monday morning, March 15th, it was performed.

"More serious than either or both of the others, it is yet a great privilege to be able to report on the date, April 21st, an apparently rapidly approaching recovery. I have not yet had a single twinge of neuralgic pain, although after both the other operations I had them the same day. I weigh as much as before the operation; my appetite is

excellent, and I sleep naturally seven or eight hours in the twenty-four. My brain on the left side, which for weeks was weak and full of sad thoughts, seems now to be almost up to normal condition. It is rapidly improving day by day. My memory, at first somewhat impaired, is improving. The tired feeling of the brain is rapidly disappearing; soon all old-time studious habits will return, be a delight, and I trust may be safely indulged in. The taste on the left side of my mouth is somewhat impaired, and the one part of my face I cannot move is the brow above the left eye."

The above history is given in the patient's own words, and shows a period of ten years of most intense suffering. The history of previous cases shows that the right side of the face was affected twice as often as the left. This evidently commenced in the third division or the inferior dental of the left side. There seems to be no apparent cause for the neuraigia unless it was due to excessive mental work. The affection commencing in the inferior dental gradually extended until all the branches of the Gasserian ganglion were involved, extending from the periphery toward the brain.

Operation. Hartley-Kraus method; osteoplastic flap in left temporal region, of horseshoe shape, one end of incision one-half inch in front of the ear, the other end one inch behind the external angular process. The bone was divided the entire length of this incision with a grooved chisel, resembling the graver's tool. I can strongly recommend this instrument for dividing the bone when it is designed to retain the bone as a part of the flap, as I did in this operation.

When the flap was turned down it was found that the anterior branch of the middle meningeal artery was in a canal in the bone, and was torn when the bone was turned down. The bleeding vessel was ligated with a sterilized catgut ligature, and gave no further trouble. During the division of the bone the dura was opened at a single point near the anterior angle of the wound, and served a very good purpose in allowing the cerebro-spinal fluid to escape, and rendered the raising of the temporo-sphenoidal lobe from the middle fossa much easier and safer than could have been done if the cerebro-spinal fluid had not escaped.

There was little hemorrhage during this step of the operation. By gentle manipulation the dura mater was separated from the somewhat irregular surface of the floor of the middle fossa until the Gasserian ganglion was reached, lying upon the anterior surface of the apex of the petrous portion of the temporal bone. It seemed to me as if at this point the dura divides or splits, one-half going beneath and the other above the ganglion of Gasser.

The light which I used, and which lighted up the cavity admirably, was an electric light held by an assistant directy behind my head. The whole area of operation was beautifully lighted up, and the most minute parts could be distinctly seen. The first part that came distinctly into view when I reached the ganglion was the beautifully white shining inferior maxillary nerve, extending from its origin from the ganglion to its point of exit from the cranial cavity through the foramen ovale. This nerve was seized with a blunt hook, which I had made expressly for the operation, and drawn into the cranial cavity as much as possible. I was surprised to find how firm and unyielding the nerve was. While this traction was being made I took a pair of sharp-pointed scissors and cut the nerve as close to the foramen ovale as possible. After the nerve was divided its distal end retracted so much that it entirely disappeared from view. The proximal end of the divided nerve was seized with firm, grasping forceps, and torn away from the Gasserian ganglion. After this the superior maxillary nerve, or second division, was seized with the blunt hook and pulled into the cranial cavity and divided in the same way as the third division. When this nerve was divided there was quite a free flow of blood. This was checked with sterilized gauze packed into the wound and retained there for a few minutes. The distal end of this nerve retracted and disappeared from view within the foramen rotundum. The proximal end of this nerve was seized with forceps and torn away from its ganglion. The ganglion was then curetted and picked away as much as possible, but the ganglion was not removed as one mass. To make sure that the entire second nerve was taken away, I examined the foramen rotundum several times with the blunt hook, and each time there was the same

free hemorrhage that occurred when the second nerve was divided. As the dark blood freely flowed it seemed like venous blood, and probably came from a wound in the cavernous sinus. The hemorrhage was easily controlled by packing the cavity with sterilized gauze, and allowing it to remain for a few minutes. I allowed the gauze to remain long enough to completely stop the hemorrhage, and when the last packing was removed the wound was so dry that it was closed without drainage. The bone and skin flap were brought into place and stitched with catgut sutures, a dressing of sterilized gauze was placed over the wound and retained with roller bandage. The eyelids were stitched together, and a compress and bandages placed over the eye. The primary dressing was kept on for six days, and when at the end of this time it was removed, the wound was healed throughout its entire extent, without a drop of pus or a blush of redness. He required no opiate after the operation. Suffered not a twinge of the old pain from the moment of the operation. Small doses of the bromide of potassium were given from time to time for a few days subsequent to the operation. This was all the medicine he took, excepting an occasional dose of saline to move the bowels. The stitches were removed from the eyelids at the time of removal of the first dressings. There were never any signs of trouble with the cornea. At the end of sixteen days he left the hospital with the wound entirely healed and entirely relieved of his intense sufferings.

There has been some impaired sensation on the left side of the face, some loss of sense of taste on the left side of the tongue, and loss of motion of the brow over the left eye. The most marked symptom is inability to call up or speak certain names. It seems to be a limited amount of aphasia. This has been present from the first, but is gradually disappearing.

DISCUSSION.

Dr. G. R. Fowler, of Brooklyn.

I know the patient referred to very well. He once applied for admission into my service at the Methodist Episcopal Hospital in Brooklyn, but improved greatly while waiting for admission. The statements concerning his sufferings have not been at all exaggerated.

I desire to state in this connection that the two cases of ligature of the common and external carotid in an attempt to deprive the Gasserian ganglion of its blood-supply, which I reported to the Association last year, are still free from a return of the theretofore intractable neuralgia of the fifth nerve, for which the operations were performed.

SUCCESSFUL TREATMENT OF SARCOMA BY ELECTROLYSIS AND CATAPHORESIS COMBINED WITH THE INTERNAL USE OF DONOVAN'S SOLUTION.

By J. McFADDEN GASTON, M.D.,
ATLANTA, GA.

THE distinguishing features of benign and malignant tumors are supposed to depend upon the difference in origin, and while other abnormal growths result from the development of micro-organisms they have no part in these neoplasms.

The various benign tumors are produced from tissues corresponding to those of their seat, and are styled homologus; while the malignant tumors have different elements from the surrounding structures, being designated as heterologus formations.

It is held by some pathologists that the source of malignant growth is found in the fœtus, and that the pre-existing state leads ultimately to the modification of structure presented in post-natal conditions. Yet this does not seem compatible with the usual late appearance of malignant neoplasms.

Professor Senn thinks that the definition of a tumor should explain its origin, its histological characteristics, and its behavior toward its immediate environment. He refers to the different attempts to define tumors, and gives his own as follows: "A tumor is a localized increase of tissue, the product of tissue-proliferation of embryonic cells of congenital or post-natal origin, produced independently of microbic causes."

This may convey a definite idea to those who are satisfied with Cohnheim's theory, but I must confess that it does not give

me a clear conception of the essential pathological features of tumors, and I am disposed to hold on to the old, simple definition, which I have given for many years in opening my lectures upon tumors, viz.: "A tumor is an abnormal development of tissue, independent of the ordinary results of inflammation." This is free from ambiguity and contains no contested points, which cannot be said of the above definition.

The treatment of uterine fibroids by the Apostoli methods of applying electricity has been attended with fairly good results, and the cauterizing effects of electro-cautery have been generally satisfactory in the lesser cutaneous growths, but so far as known to me the field of malignant tumors has only recently been explored by electricity, so as to yield practical results.

Dr. G. Betton Massey directed attention to a new treatment of sarcoma, at the meeting of the Medical Society of Pennsylvania, May 21, 1896.[1] This is based upon the curative action of electricity, which "requires a soluble zinc electrode as positive pole, freshly coated with mercury at each application, and properly insulated. This electrode of a size and shape adapted to each case is inserted into the tumor after a small opening is made by negative electro-puncture, under the chloride of ethyl spray, and with a properly adjusted large negative pole as indifferent pole, a current of from 100 to 200 milliampères may be gradually turned on," and repeated daily until a cure is effected.

"Under this method the tumor is gradually disintegrated, and much of it discharged through the opening; the area of induration about it shrinks progressively until finally the malignant growth is replaced by a healthy wound, which is ultimately allowed to heal, but not until the whole of the morbid tissue is destroyed or transformed into granulation tissue."

It is notable that the process adopted by Dr. Massey contemplates a comparatively rapid breaking down of the morbid structure and a disintegration with discharge of the débris, whereas the course pursued in a different class of cases by Dr.

[1] Amer. Medico-Surgical Bulletin, June 27, 1896.

Robert Newman is only "to use the weak currents of from three to four milliampères, seances lasting not more than from five to ten minutes, with intervals of about one week or longer. He says that electrolysis acts as a chemical decomposition by absorption, which never burns or destroys tissues. It is not followed by hemorrhage or other unpleasant consequences."

The internal use of the preparations of arsenic, urged especially by Lawson, and the employment hypodermically of the antitoxin by Coley, have been attended with benefit in some cases, and failure in others.

The feasibility of curing a malignant growth without surgical interference by the knife or cauterization has been thought questionable; and yet there are some instances of the disappearance of tumors which were recognized as malignant neoplasms under the influence of constitutional and local measures which are worthy of consideration.

In view of facts indicating the practicability of treating malignant inoperable tumors by electrolysis and cataphoresis, I undertook the management of a case in which the diagnosis of sarcoma was previously made by three or more colleagues based upon macroscopic and microscopic tests.

A white boy, aged twelve years, suffered for some months from a growth in the hypogastric region, and was placed under the care of Dr. J. B. S. Holmes, of Atlanta. An exploratory incision was made by him diagonally across the right flank above the internal abdominal ring, and into the indurated mass of the tumor. It was found that it presented the characteristics of sarcoma, with such adhesions to the surrounding structures as to preclude any attempt to remove it by the knife. The incision was accordingly closed, and an unfavorable prognosis of the case was given to the parents of the boy. Dr. William Perrin Nicolson, of Atlanta, examined the patient also and concurred in the views of Dr. Holmes. It was afterward determined to take the patient to Richmond, Va., where Dr. Hunter McGuire examined the case and reopened the incision, so as to procure a specimen of the tumor for microscopic investigation. He was impressed with the serious nature of the case, and declined to undertake any radical operation. The result of a careful examination of the specimen with

the microscope by Dr. M. D. Hoge, Jr., of Richmond, indicated that the tumor was a small round-celled sarcoma, and thus confirmed the previous diagnosis in the case.

This patient was turned over to me for examination on November 16, 1895, and I found an abdominal tumor, extending from near the anterior-inferior spinous process of the ilium and the adjacent portion of the pubic bone across to nearly the corresponding line on the opposite side, and reaching from near the symphysis pubis to the umbilicus, with marked induration of the mass. There was no mobility in the tumor, and adhesions seemed to exist between its anterior surface and the abdominal wall. An exact measurement of the outlines of the tumor gave in the transverse diameter six inches, in the longitudinal diameter seven inches, in circumference twenty-one inches.

The anterior surface was smooth and somewhat prominent, but without any salient projection. Moderate pressure by palpation was borne without flinching, and there was no complaint of sharp pain or discomfort in that region. The general condition of the boy was that of cachexia with pallor and weakness, but without any marked emaciation of body or limbs. With these facts before me the history of the family, given by the father of the boy, threw no light upon the case, and I felt constrained to accept the view of the case taken by my colleagues, as reported to me.

It was evidently impracticable to do any radical surgical operation, and although I was not aware that Dr. Massey had then reported his cases,[1] nor had I received any report of success in the use of electricity for sarcoma, I came to the conclusion that it offered some prospect of relief in this case. Upon stating my conviction to the father, who is a very intelligent man, he manifested a favorable disposition toward accepting my proposition as a *dernier ressort*. My suggestion was adopted also in regard to combining an alterative course of internal treatment, with the resort to electrolysis locally, and the following prescription, which I have found to exert great resolvent influence in other cases, was ordered for the patient: R. Syrup trifolium compound (Parke Davis) 3½ fluidounces, Donovan's solution (liq. ars. et hyd. iod.) ½ fluidounce. Mix and take a small teaspoonful with water three times a day. It may be stated that each fluidounce of the trifolium syrup contains the following: Red clover-blossoms, 32

[1] Medical News, March 9, 1895; Journal Amer. Med. Association, August 29, 1895; Philadelphia Polyclinic, October 19, 1895.

grains; styllingia, 16 grains; lappa, 16 grains; phytolacca root, 16 grains; berberis aquifolium, 16 grains; casca amarga, 16 grains; xanthoxylum, 4 grains; iodide of potash, 8 grains.

This was employed simply as a menstruum for the more active preparation of the double iodide of mercury and arsenic, known as liquor arsenici et hydrargyri iodidi in the *United States Pharmacopœia*. The patient got about one grain of iodide of potash with eight drops of Donovan's solution in a teaspoonful of the mixture three times a day, and took it, without any disturbance of his stomach or bowels continuously, while electrolysis was applied to the tumor.

I am giving a somewhat minute account of the medical treatment in this case so as to enable others to judge of the influence of medication upon the result when considered in connection with the application of electricity locally. On November 17, 1895, I commenced the use of electricity with a twelve-cell battery, manufactured by Waite & Bartlett, having the cups of glass, in which the zinc and carbon plates are immersed, in a solution of bichromate of potash, and kindly furnished by Dr. J. A. Childs, of Atlanta.

The needle representing the positive pole was introduced into the substance of the right side of the tumor, and the sponge-electrode, representing the negative pole, about two inches in diameter, was placed on the left margin of the tumor, having the connection of six cells and keeping up the current for five minutes daily. Seance was gradually increased during the first week and afterward, until the time was extended to ten minutes, the punctures were made about half an inch apart, going around the outer border of the tumor; and after November 25th, the applications were only made on every alternate day until April 20, 1896, when they were made every third day. In the meantime the needle was changed to the negative pole, and on December 29, 1895, Donovan's solution was commenced upon the positive pole, by saturating a small piece of cotton with it and laying it upon the central portion of the moistened sponge-electrode. This process is known as cataphoresis, by which medical substances are introduced into the body with the galvanic current. Knowing that Dr. Hunter McGuire had obtained satisfactory results in the treatment of goitre by this means, I wrote to him for information as to the method of procedure, and he kindly furnished me with an account of the process adopted in his cases, which has served as a guide in my application of the medicated electricity in this case.

Having no means of estimating the voltage or amperage, with the

resistance by ohms, I depended upon the manifestation of local effects, and graduated the number of cells accordingly. When the fluid has become weaker by repetition of the current the number of cells has been increased, and after renewal of the fluid fewer cells have again been employed in making the applications. Without regard, therefore, to an accurate scientific record, the clinical result has been closely watched, and in the course of the treatment a larger battery has been used so as to get the effect of a weaker current diffused over more space by having a larger number of cells included in the connection of the poles. This was resorted to when the force of the galvanic current was materially lessened by repeated applications of the battery with the same fluid. And as many as thirty cells have thus been brought into the circuit without any marked inconvenience to the patient. The effect was marked by minute vesication alternated with small pits over the part to which Donovan's solution was applied, while the usual liberation of gas and some exudation of fluid occurred around the needle of the negative pole. After encircling the entire tumor with the punctures, the needle was dispensed with, and another sponge-electrode substituted for it, when no sign of any irritation was apparent at the negative pole; but the vesication continued to appear at the seat of the positive electrode when it was applied for as much as ten minutes with the pledget of cotton soaked in Donovan's solution placed on the moist sponge.

During the application of the galvanic current with the needle, whether on the side of the positive or negative pole, there was p in to a marked degree, and this was indicated by yells and screams on the part of the boy from the beginning to the end of the seance so as to attract the attention of all the neighbors. There was less suffering with the use of the positive and negative sponge-electrodes, and eventually the 12-cell battery was changed for my own of 30 cells, with a gradual increase to 15, 20, and 30 cells in the circuit, applied every five days. The internal administration of the syrup of trifolium compound and Donovan's solution was changed in February, 1896, for a combination of the same quantity of Donovan's solution with 5½ ounces of succus alterans, which consists of the following in each pint: 16 Troy ounces of styllingia sylvatica, smilax sarsaparilla, phytolacca decandra, lappa minor, and xanthoxylum Carolinianum (Eli Lilly). A teaspoonful of this mixture was taken three times a day. It will be observed that the chief difference of this from the other compound is that the iodide of potash is omitted. I observed, in

studying authorities upon this matter, that Dalton included among the incompatibles with Donovan's solution the salts of the alkalies, and hence I used as a menstruum the succus alterans.

In the meantime notable changes were observed in the size and density of the tumor and in the general condition of the patient. The border line had receded decidedly from its original limits, excepting at its encroachments upon the horizontal ramus of the right pubic bone, where it remained in such close proximity as to give the impression to the touch that the tumor was attached to the bone.

Proximate measurement of outline of tumor at different dates.

The measurements on March 1, 1896, of the tumor, made by my son, Dr. J. McF. Gaston, Jr., gave for the longitudinal diameter 5 inches, for the transverse diameter 4½ inches, for circumference 15½ inches, showing the great reduction in the respective dimensions of 2 inches, 1½ inches, and 5½ inches from those of November 18, 1895, being three and a half months.

Another measurement, made July 29, 1896, by my son, was as follows: Longitudinal median line 3½ inches, transverse line at broadest line 3 inches, circumference 10½ inches, making a reduction in four months in the respective dimensions of 1½ inches, 1½ inches, and 5 inches in the previous measurement. The mobility of the small mass remaining was now very notable, when the tumor was caught up between the thumb and fingers; but there was still an attachment between the tumor and the parietal wall, and some slight oozing of a serous nature from the outer end of the incision. This appeared to discharge from the substance of the tumor, and indicates persistent degeneration in it.

The general health of the patient has very materially improved, and having undergone examination at different periods since being under my care, by Drs. Hunter McGuire, J. B. S. Holmes, Arch and J. C. Avery, they all coincided in the favorable progress of the case.

Upon furnishing the details of my treatment in this case to Dr. G. Betton Massey he expresses his gratification at my success, and regards it as a confirmation of the claims made in his paper, to which I have referred, and also in a previous one read before the Philadelphia County Medical Society, January 9, 1895. He infers correctly that I had not seen the earlier paper, thus affording another instance of the independent conception of another novelty in surgery. This point has been illustrated by my previous experience on several occasions, but my view is none the less original from being anticipated by another, with also priority of publication. Dr. Massey expects to present a paper at the forthcoming meeting of the American Medical Association in further demonstration of the result of his mode of treatment.

My case illustrates another phase of electrolysis and cataphoresis. There was a marked diminution in the induration of the tissue and in the general prominence of the mass, with less discharge from the incision which had been made by my colleagues before the case was placed under my care, and had only partially closed by granulation.

It should be noted that the only restriction made in the diet of the patient from the outset of the treatment was to exclude

all greasy food and highly-seasoned dishes, and the digestion was good during the use of the medicine and cataphoresis for more than a year without interruption. He has only taken a teaspoonful of the succus alterans and Donovan's solution once a day for the past three months, and has used the medicated electricity by cataphoresis once a week for fifteen minutes at each seance. During the month of March he was laid up with an attack of mumps (parotitis) for more than a week, and suspended the regular treatment for the appropriate remedies to combat this acute condition, but the use of his special course has since been resumed, and he has returned to his duties at school, presenting no traces of disease of a local or constitutional nature at the present time.

We are prepared by the foregoing considerations to make the following inferences:

1. That the diagnosis of sarcoma being made by clinical observation and confirmed by the microscope, there ought not to exist any question as to the nature of the disease.

2. The evident adherence of the tumor to the abdominal viscera, and especially to the front wall of the abdomen, precluded surgical interference with the knife, and thus placed the case under the class of inoperable tumors.

3. Having a reasonable ground to expect some benefits in malignant growths from medicinal treatment, the combination of mineral and vegetable alteratives affords the best prospect of relief in this condition.

4. The history of the treatment of benign tumors with the continuous galvanic current gives encouragement for its application in cases of a malignant type, and especially in that variety of neoplasm known as sarcoma, in which its efficacy has been recently tested.

5. It is not requisite to employ a destructive, or disintegrating effect of the continuous electric current to secure the favorable action upon tumors, and the process of electrolysis may be initiated with a few cells and gradually increased, without disintegration at either electrode.

6. This treatment may be commenced with the needle at the

positive pole and the sponge-electrode at the negative pole of the Waite & Bartlett battery, and so placed as to pass the current through the substance of the tumor. After the daily application thus for a week or ten days, the needle may be used with the negative pole and the sponge with the positive pole, making the applications on alternate days.

7. The employment of cataphoresis, in which medication is applied upon the positive sponge-electrode, while either the needle or sponge-electrode is connected with the negative pole, induces some irritation of the skin when the medicine is applied and conveys its properties into the substance of the tumor.

8. While the exact estimate of the force of the electric current would promote scientific results, the clinical observation of the effects upon the tissues subserves all practical purposes in the treatment of tumors by electrolysis and cataphoresis; and it is not requisite to be provided with the appliances for measuring the voltage and amperage or ohms of resistance in the use of the battery. The time occupied in accomplishing a cure by the moderate current of electricity is greater than that which would be taken in a more violent application, yet the freedom from any destructive process renders the former more satisfactory to the patient.

9. My case, added to those already reported in which medicated electricity has been efficient in the removal of malignant tumors, should warrant the profession in resorting to this mode of treatment. I can further vouch for the efficacy of internal medication with electrolysis and cataphoresis in the treatment of sarcoma

10. Theoretic views in regard to the origin of malignant tumors should not prove a barrier to the adoption of general and local measures of treatment which have been employed with satisfactory results in a case clearly diagnosticated to be sarcoma. Clinical observations in the progressive development of the neoplasm, with macroscopic and microscopic tests, clearly indicate its malignant character.

11. The process of atrophic decomposition and resorption

of the sarcomatous structures under the operation of the medicated electric current favor the expectation that tumors of a carcinomatous nature may undergo like changes with similar treatment. We are, therefore, warranted in resorting to cataphoresis as a tentative measure of treatment for all kinds of malignant tumors.

A PRELIMINARY COMPARISON OF METHODS AND RESULTS IN OPERATIVE SURGERY AT THE SEA-LEVEL (NEW YORK), AND IN PLACES OF HIGH ALTITUDE (DENVER).

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IN laying before such a competent surgical tribunal an initial contribution, the author regrets that he has not a subject embodying the results of more extended observation. Absence of literature renders it necessary to place entire reliance on personal data in the consideration of the topic to which the attention of the Association is invited.

In July, 1894, it was my fortune to go from the city of New York to Denver, Col., there to engage in the practice of surgery. It was found that the climatic conditions of the latter city differed materially from those obtaining in the East. Denver is one mile above sea-level. The mean barometric pressure is only 24 : 52 inches, so that the air-pressure upon the body surface is reduced from fifteen pounds per square inch to twelve pounds. The climate is distinctly a cool one, and bracing. The air is not only thin but very dry, the mean relative humidity being but 50 per cent., and the absolute moisture 1 : 8 grains to the cubic foot. The sky is for the most part cloudless, there being but sixty days in the year when the sun does not shine. As a result the days have a brilliance which greatly increases the apparent warmth. The sunshine is very hot, even on days when the air itself is below freezing. This dry clear air, with its increased diathermance, renders the winters mild and pleasant, and the great contrast between sun and shade gives relief and

comfort in the summer. Radiation is rapid, and the nights are always cool.

The effect upon the newcomer, especially if he be an invalid, as so many of the residents are, is immediate and marked. The appetite is improved, the nutritive processes and tissue metabolism are increased and accelerated. Respiration is deepened, and for a time somewhat quickened. The nervous system especially feels the intoxication of the bright, dry, sunny air. The sense of energy and well being is an immediate and continued pleasure.

The dry air rapidly absorbs the insensible perspiration, so that the skin is always dry and cool. This greater rapidity of evaporation and radiation is very marked, and as the climatic conditions differ so materially from those at the seacoast, it may be surmised that these differences have something of an effect on the field of operative surgery; I have, therfore, endeavored to make a careful estimate of the value of these factors, but this estimate is only a preliminary one, for my observation has not as yet been sufficiently extensive. While a basis for comparison rests upon eleven years of daily surgical work in the hospitals and dispensaries of New York City, experience in the new region has been limited to 248 operative cases. These were cutting operations done under general anæsthesia, and do not include such procedures as the reduction of dislocations, the putting up of simple or compound fractures under ether or chloroform, the breaking up of joint adhesions and the like, or the minor operations done under local anæsthesia. Two hundred and eleven out of the 248 cases occurred in private consultation practice. The subjoined list[1] indicates the character of the operations.

[1] HEAD AND NECK. For dermoid cyst of neck, 1; for tubercular glands of neck, 5; for necrosis of skull, syphilitic, 1; excision of upper jaw for carcinoma (death from exhaustion), 1; staphylorrhaphy, 1; staphylorrhaphy and uranoplasty, 1; for deep abscess of neck, 3; blepharoplasty, 1; for acute suppurative glossitis, 1; excision of tongue for carcinoma (death from bronchitis), 1; for epithelioma of lip, 5; for carcinoma of upper jaw, 1; for sarcoma of neck, 1; for calculus in submaxillary gland, 1; for septic wound of face, incision and drainage, 2; for epithelioma of nose 1; for dermoid cyst of orbit, 1; for necrosis of lower jaw, 3; for tuberculosis of tongue, 1; for hare-lip, 2; for cystic tumor of neck, 1; for tumor of parotid, 1; extirpation of parotid for carcinoma, 1; for osteoma of lower jaw, 1; external œsophagotomy for impacted foreign body, 2; for com-

The cases have the following regional distribution: Head and neck, 54; chest and trunk, 33; abdomen, 36; genito-urinary, 34; rectum and anus, 19; extremities, 72.

There have been eleven deaths: one after exploration of the brain (error in diagnosis, pre-existing suppurative meningitis),

pound depressed fracture of skull, 3; for supposed abscess of brain, which proved to be suppurative meningitis (died), 1; for old bullet wound of skull, trephining with removal of depressed bone, 1; for gunshot-wound of neck, 1; for branchial cyst of neck, 1; plastic on ear, 1; plastic on face, 4.

CHEST AND TRUNK. Abscess of chest-wall, 1; for melano-sarcoma of back, 1; for keloid of chest, 1; for cystic tumor of back, 1; for empyema, 3; for bullet in the chest-wall, 1; for carcinoma of breast ("complete" operation), 14; for abscess of breast, 3; for adenoma of breast, 1; for recurrent carcinoma of breast, 1; for fibroma of breast, 1; for tuberculosis of breast, 1; for cyst of breast, 2

ABDOMEN. For acute appendicitis, 14; for appendicitis and general suppurative peritonitis (died), 2; for relapsing appendicitis, 2; for gallstones in the cystic duct (died of shock and exhaustion), 1; for abscess of mesentery and general peritonitis (died), 1; for abscess of liver, operation in two stages, 1; exploratory laparotomy, 3; gastrostomy (died in twenty-four hours from exhaustion), 1; for ovarian cyst, 3; for strangulated inguinal hernia, 2; radical cure of inguinal hernia (Bassini), 5; for cyst of spleen, operation in two stages (died of septicæmia and exhaustion on twentieth day), 1.

RECTUM AND ANUS. For polypoid growth, 1; for adenoma, 1; for hæmorrhoids, 8; for tubercular ulcers, 1; for prolapsus, 1; for fistula in ano, 7.

GENITO-URINARY. Circumcision, 6; external and internal urethrotomy, 6; for carcinoma of bladder, suprapubic cystotomy (died), 1; for varicocele (Bennet's operation), 6; internal urethrotomy, 2; suprapubic cystotomy for foreign body, 1; suprapubic cystotomy for stone, 1; nephrotomy and nephrectomy (died of exhaustion), 1; orchectomy for tuberculosis, 1; orchectomy for sarcoma, 1; for hydrocele (Volkmann's operation), 2; suprapubic cystotomy for tuberculosis, 1; for rupture of urethra and extravasation of urine, 1; plastic on male perineum, 1; perineal cystotomy for carcinoma (died of exhaustion), 1.

EXTREMITIES. For foreign body in knee, 1; Thiersch's skin grafting, 7; for necrosis of tibia, 5; for abscess of thigh, 4; for lacerated wound at wrist, tenorrhaphy and neurorrhaphy, 1; for suppurative arthritis of elbow, drainage, 1; for cystic tumor of thigh, 1; for tuberculosis of tarsus, 4; for malunion of femur, 1; for suppurative arthritis of knee, drainage, 1; for ganglion at wrist, excision, 1; for deep cellulitis of leg, incision and drainage, 4; for necrosis of ulna, 1; for necrosis of femur, 1; for old sinuses of thigh, 1; for bullet in foot, 2; for tubercular osteitis of ulna, 1; for deep abscesses of thigh and leg, 1; for osteomyelitis of tibia, 4; for caries of carpus, 1; excision of elbow for tuberculosis, 1; for fatty tumor of shoulder, 1; for malunion of bones of forearm, 2; tenorrhaphy and skin grafting, 1; incision for suppurative phlebitis, 1; for gonorrhœal arthritis of elbow, drainage, 1; for hammer-toe, 1; for hallux valgus, 2; for ununited fracture of humerus, 1; amputation of fingers, 4; amputation through forearm, 1; amputatiom at elbow, 1; amputation through upper third of arm, 1; amputation at shoulder, 2; amputation of toes, 5; amputation at knee, 1; amputation through middle of thigh, 1; amputation of leg, 2.

one after excision of the upper jaw for cancer (shock and exhaustion), one after excision of the tongue for carcinoma (acute bronchitis), one after operation in two stages for enormous hæmorrhagic cyst of spleen (septicemia, death on twentieth day), one after nephrectomy for suppurative kidney (exhaustion), two after operation for general suppurative peritonitis due to appendicitis, two of exhaustion after cystotomy (one perineal, one suprapubic), for cancer of bladder, one from exhaustion after gastrostomy, one from shock and exhaustion after choledo-lithotomy, and one after operation for general suppurative peritonitis due to abscess of mesentery. In all instances the history has been carefully kept and closely studied. It is felt, therefore, that while the future with its wider observation may lead to a modification of present views, these 248 cases permit of a preliminary comparison.

This comparison is by no means easy to formulate. It must be in large part a personal estimate. Many factors enter into such a broad problem, but the greatest difficulty arises, perhaps, in weighing the general condition of the patient before the operation and at the time of its performance. This estimate can only be made in a general way, and one must rely chiefly on the impressions left upon him as he works from day to day; this is to be supplemented by perusal of the histories of the cases.

It would seem that the selection of cases in Denver requires some modification of the laws which one is accustomed to follow in the East. So, in general, it seems proper to refrain from operating on people who have recently come up from tide-water, unless the operation be one of emergency or of very brief duration. The rarefied atmosphere makes necessary increased action of the heart and lungs, and I have on several occasions seen marked embarrassment of the circulation in patients undergoing short operative procedure, they having presented no cardiac evidences before operation, and being people in whom no untoward symptoms would ordinarily be expected. Especially is operation to be avoided in newcomers who show evidence of cardiac weakness. As an illustration may be cited the case of a young

gentleman of seventeen years, who, while on a hunting trip in the Rockies, sustained a severe laceration of the face, with compound fracture of the superior maxilla. Wound infection quickly set in, and was fully developed when the patient arrived within reach of surgical aid. The action of the heart was somewhat irregular and intermittent, and this irregularity was markedly increased when slight anæsthetization was made for the purpose of incision and wound cleansing. As half of the upper lip and the entire cheek were torn up, a fairly extensive plastic operation was necessary, and for this it seemed best that the patient should return to his home in New York. There a two and one-half hour operation was safely carried out.

Other cases have served as well to impress on me the provisional thought that patients with marked cardiac weakness had, in the absence of contraindication, best go to the sea-level for surgical operation. But while, as said, the newcomer may well postpone his operation for a few weeks, or return to the sea-level for it, I am inclined to believe that the converse holds good, and that those thoroughly acclimated bear surgical procedure better at the high altitude than at a lower. This is especially true of the pulmonary invalid, for those whose lungs are in any way impaired feel very markedly a depression and an embarrassment of respiration when they encounter increased humidity of the atmosphere, and I can but feel that this embarrassment must be much augmented by the administration of an anæsthetic. Paul Bert, Eggers, and others (Solly), have shown that the number of red blood-cells is materially increased in climates exemplified by Colorado, and I am inclined to think that pulmonary and certain other invalids in whom operation is to be done, but in whom delay is permissible, may perhaps be placed in better condition by a sojourn in a high, dry climate.

The preparation for operation and the organization itself should be the same wherever we are; it should be the very best possible, and no detail is to be overlooked which inures to accuracy in technique or to the rapidity with which a given procedure may be brought to a close. I am much in sympathy

with the views set forth by Dr. Dudley P. Allen in the admirable paper read before this Association one year ago on the relative temperatnre and moisture of the atmosphere of the operating-room, and had myself formulated the conclusions at which he arrives. I feel that the best atmosphere for the operating-room is that in which the patient is wont to live,[1] and that hot, moist air is even more depressing to him than to the operator and bystanders. Especially is this important to those who live in a dry climate, where radiation and evaporation take place so rapidly. Care must be taken to keep the patient well wrapped in woolen garments, to preserve the body heat, and to augment it by appropriate measures in suitable instances. These rules apply with increased force to those who have pulmonary tuberculosis.

In the choice of the anæsthetic a study of my cases would seem to show that ether is, in general, more irritating to the mucous membrane of the respiratory tract than is the case in a moist climate. I have been particularly struck by the frequency of profuse bronchorrhoea during etherization, and I find that in 36 cases it has been found necessary to change to chloroform during anæsthetization because of this. A rational cause for this would seem, perhaps, to lie in the fact that as the lungs are normally accustomed to the inhalation of a comparatively dry gas, the moisture of the vapor of ether is particularly irritating. However this may be, I find that I am getting to place more and more reliance on chloroform, and while the rule to employ ether unless there be present some distinct indication for chloroform has not as yet been reversed, the field for the employment of chloroform has certainly been very much broadened in my practice. Of the 248 operations ether was employed in 159 and chloroform in 89. I attribute one of the deaths to the administration of ether. The case was that of a man of sixty-nine years, who was to undergo excision of the tongue. The heart being very weak, ether was thought the safer anæsthetic, but profuse bronchorrhea necessitated a speedy change to chloroform. A rapidly developing bronchitis proved fatal on the

[1] I have not as yet found abdominal operations to require a special atmosphere.

fourth day. This bronchitis was not due to the entrance of blood to the trachea.

The relative amount of surgical shock shown in operative work at high altitudes is something regarding which difference of opinion obtains among the Denver surgeons. On first taking up work in this city I found a general impression to the effect that shock was more severe than at the sea-level, and that especially active means had to be employed to combat this. My observations do not tend to bear this out. Indeed, a careful scrutiny of my cases thus far has tended to show that under the same conditions, with assistance equally valuable and organization equally complete, patients who possess the same health and strength bear surgical operations rather better in Colorado than in New York. To put this in another and perhaps a plainer way: if two individuals, one of whom had lived for some years in Colorado while the other had lived in New York, and who were found to be in the same general condition should be subjected to the same severe operative procedure under precisely similar conditions, I am inclined to think that the Colorado patient (operated in Colorado) would bear the operation rather the better.[1] Resistance seems to be greater and reaction more rapid, and this again is especially true of the pulmonary invalid.

Hemorrhage in general seems to be rather less profuse in the places of high altitude, particularly the oozing from the smaller vessels, and we may well surmise that atmospheric dryness would conduce to capillary hæmostasis. In areas which have for some time been the seat of chronic inflammation, however, the bleeding seems to be somewhat more troublesome than in the same class of people at the sea-level. I refer in this to those who have been residents of the high regions for some years; but why this should be so I am unable to say, and it may be that I have encountered a series of exceptional cases, and that further experience may lead to a modification of this thought.

[1] This is simply a personal opinion. I have carefully studied the interesting paper by Dr. H. G. Wetherill, published in the Annals of Surgery in April, 1897. The arguments set forth therein are very ingenious, but I find myself unable to agree with either the premises or the conclusions in so far as the latter assert that surgical shock is greater in the higher altitudes.

I am inclined to think that bleeding is a little better borne by our high altitude people; it seems to me that saline infusion and similar measures are rather less frequently demanded. A reason for this may, perhaps, be found in the increased number of red blood-globules and the markedly increased chest expansion which more than compensates for the thinness of our atmosphere.

So far as wound healing is concerned, operations on aseptic fields doubtless yield the same results as do those done under similar precautions at the sea-level. I find that of my 248 opertions, 101 were "clean" procedures, and of these 97, or 96 per cent., healed without suppuration, while in the remaining 4 cases the infection was but slight (in some part of the suture line), and did not retard convalescence. Cases in which infection has occurred are, I am inclined to think, rather more easy to manage than in moist climates, and indeed we may reasonably argue that the drier the atmosphere the less favorable must be the conditions for germ growth.[1]

There is one class of surgical cases which does better in such a climate as that of Colorado than in a lower, moist country, and that class embraces the tuberculous.

Not only am I inclined to the belief that these cases heal more rapidly and that the healing is much more permanent, but I am impressed by the small proportion of pulmonary invalids who develop surgical tuberculosis. The percentage is, I feel certain, smaller than obtains under less favorable climatic conditions. Cases of genito-urinary tuberculosis, tuberculosis of the bladder, of the prostate, or of the testes make decidedly better progress than was made by similar cases which were seen in the East. Again, in cases of chest drainage for empyema the greater lung expansion must tend directly toward a more rapid obliteration of the cavity.

It must not be assumed that the differences that have been indicated between operative surgery at the seacoast and in

[1] Dr. E. H. Norton, formerly house surgeon to the New York Hospital and Surgeon to the Fitch Accident Hospital at Buffalo, who is in charge of large coal mines at Rock Springs, Wyoming (altitude 6000 feet), writes me that the severe accidents incident to mine surgery show far less infection than would be probable in a moist climate.

mountainous regions are marked, for they are not. The majority of such cases pursue their course on similar lines, and differences, when present, are as a rule only slight. I have endeavored to indicate in a brief way some of the peculiarities attending surgical work in high altitudes, feeling, as I have said, that my experience is as yet insufficient to permit of more than provisional statements, and in conclusion beg to sum up as follows:

1. Operative surgery in dry climates having an altitude of one mile or thereabout is to be pursued on the same general lines which govern it at the sea-level. However,

2. Care must be exercised in subjecting those recently from a lower altitude to severe or prolonged surgical procedure, especially if the patient be a pulmonary invalid or if he exhibit cardiac weakness; and

3. It would seem that those who are thoroughly acclimated bear operation rather better when at home than when they go to tide-water, and this again is particularly true of patients afflicted with pulmonary tuberculosis.

4. Ether must be employed with greater caution, and is more of an irritant to the respiratory mucous membrane. Chloroform may find wider employment than at the sea-level.

5. The loss of blood seems to be rather less in the high, dry climate, possibly excepting cases in which the operative field is the seat of chronic inflammation.

6. Shock, also, seems to be less pronounced, patients rally rather more quickly after operation. In the tuberculous this feature seems to be marked.

7. Aseptic wound management must be the same in all regions Infection, when it occurs, doubtless makes less progress in a dry atmosphere than in one containing a greater degree of moisture.

8. It is believed that accumulated statistics will show that operations for surgical tuberculosis are attended by a greater permanency of healing in the high altitudes, and that patients presenting such lesions, but whose lungs are yet free, do all possible to ward off pulmonary invasion by taking up their abode in such a climate as that of Colorado.

A CASE OF EXTIRPATION OF POPLITEAL ANEURISM, WITH REMARKS UPON THE SUBJECT.

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It is not my purpose in this short paper to discuss the surgical treatment of aneurism, but to report briefly a case involving the popliteal artery treated by extirpation of the sac, the case being one of relapse or recurrence after an apparent cure by the Hunterian method.

This old operation, in its application to aneurisms in general, has been brought again, during the last few years, prominently before the profession, one of its most enthusiastic advocates being one of our members, Dr. Ransohoff.

My own experience, which is slight, however, in this particular field of surgery, and a glance at the recent literature of the subject would seem to justify the assertion that the old method, with modern improvements, is regaining professional confidence, as being more in accordance with our present ideas of clean and thorough work than the one which has been almost universally practised of late years.

It appears to me, from our present point of view, that all aneurisms of the extremities, where the blood circulation can be controlled during operation, should be extirpated, and the vessel tied above and below the arterial opening.

In the first place, it is the only method certain of effecting a radical cure; and if experience should prove, as I am inclined to think it will, that the dangers are not greater or so great as in the ligation of the vessel above, it should be the operation of choice in the vast majority of cases. By this radical method

we are certainly free from some of the dangerous complications which may follow the other; and if the fear of secondary hemorrhage can be eliminated its superiority would be incontestably proved. But the evidence concerning this point is not, as yet, sufficient in cases of idiopathic origin, to warrant a dogmatic opinion, although I believe that with our present dressings and technique we shall have very different results in this respect from those of our predecessors.

There may be reasons why this operation may be considered inapplicable as a primary procedure, the most potent being the difficulties often encountered in its performance in certain regions as, for instance, in the popliteal space.

I freely admit that, notwithstanding my general preference for it, I should hesitate to proceed to extirpation of a popliteal aneurism under ordinary conditions. As the usual operation gives a fair percentage of recoveries, and considering the difficulties which all who have performed it have recognized, of ligating the popliteal, I should think it my duty to recommend the former as being less hazardous to the patient. But when the case is one of relapse after the Hunterian method, there is nothing else left to be done except excision, although the difficulties remain the same. This was the condition of things in my patient, whose brief history was as follows:

J. C. H., colored male, laborer, aged thirty-eight years, resident of Washington, was first admitted to the Garfield Hospital June 4, 1893, in the service of Dr. A. A. Snyder. There was nothing in his previous history of any etiological interest. He first noticed a slight swelling in the left popliteal space during the previous month of March, which increased quite rapidly in size, accompanied with a good deal of pain, especially at night, and œdema below knee. He had continued to work, notwithstanding his condition, up to date of admission, when the tumor was as large as an orange, with strong pulsation. His temperature was 100°, and pulse 108.

The diagnosis of aneurism was perfectly clear, and, after a few days of rest and preparation, Dr. Snyder on June 13th ligated the femoral artery, under cocaine anæsthesia, at the apex of Scarpa's triangle, with a silk ligature. The patient bore the operation well, suffering

but little pain during its performance. He was discharged July 11, 1893, with the tumor apparently solid and diminished to about the size of a small hen egg.

Toward the end of 1895 he noticed a gradual enlargement of the tumor, which had never entirely disappeared, and soon the pain became so severe that he was compelled to abandon work and take to his bed. He was readmitted January 29, 1896, with the popliteal swelling as large as before the operation, suffering from intense pain, with the leg flexed and swollen. Pulsation was present, though rather indistinct, with superficial fluctuation which gave rise to a suspicion of suppuration or rupture of the sac. An aspirating-needle was inserted, and some dark, thick blood was withdrawn, but no pus. Having no doubt about the nature of the case, I had the patient prepared for February 8th, and proceeded on that date, under ether, to perform the operation of extirpation of the sac.

The elastic band of the Esmarch apparatus was placed in position around the thigh, but not tightened, and an incision, the full length of the popliteal space, was made in the middle line over the tumor. A large amount of dark blood clot was reached and turned out with the fingers, when fresh arterial blood began to flow. I placed a sponge in the wound to control hemorrhage by pressure and tightened the tourniquet. The sponge was removed and the search for the vessel begun. All the tissues were blood-stained and of the same color, making recognition of the vessels difficult. The tourniquet was loosened that I might locate the bleeding point by the flow of blood. This was at once successful, and, after tightening it again, I proceeded with the operation by attempting to separate the vessels, which I found impracticable, the vein being wounded in the necessary dissection. I applied a silk ligature to both vessels, above and below the opening, cleaned out the wound, including sac and laminated clot. Only one other ligature was applied, which was to a branch that bled when the constriction was removed.

The wound was packed with iodoform-gauze and partly closed by suture. The usual dressing was placed over the wound, which was left on for several days. He suffered considerable pain, as before, of a neuralgic character during the first week, but otherwise his condition was satisfactory, his temperature not exceeding 101.4° which it reached on the second day.

February 15th. The entire dressing removed and the wound clean without pus.

March 4th. Leg still painful, but much less severe, and wound nearly healed without suppuration. The leg remaining flexed after operation, a weight and pulley had been applied after first dressing, which rapidly straightened it.

7th. Patient walks about with the aid of crutches, with only a small superficial ulcer at point of drainage.

14th. Leg somewhat stiff and painful upon motion, and swelling about the ankle.

April 20th. Wound entirely healed, with good movement at knee and free of pain. Discharged cured.

It is an exceedingly fortunate circumstance, as has been proved in a number of cases, that the inclusion of the vein in the ligature appears to have no unfavorable influence in this operation, although I should think it ought to be avoided when possible. It is really the greatest difficulty likely to be met with in its performance, and I should have felt much embarassment from what I was compelled to do if I had not been already aware of the fact that it had been successfully done several times without apparently interfering with the healing process.

This is a difficulty not encountered elsewhere, fortunately, for in no other part of the body is the connection between vein and artery so intimate and strong as here, rendering their safe separation in many cases of disease a matter of impossibility. There had been a rupture of the sac in this case, which had probably occurred when the symptoms became acute.

The large collection of red blood-clot occupying the superficial popliteal region presented the appearance of a hæmatoma, with only slightly condensed tissue surrounding it. The real sac was revealed after this had been removed, showing a rent in its wall, and partly filled with fibrinous clot. The arterial opening was about opposite the articulation.

I have looked over the published cases up to date and find that the results have been very satisfactory. I have observed nothing in the technique of the operation as practised by others materially differing from mine, except that some have succeeded in ligating the artery without injuring the vein.

THE OPERATIVE TREATMENT OF IRREDUCIBLE SUBCUTANEOUS FRACTURES.

By JOSEPH RANSOHOFF, M.D.,
CINCINNATI.

THE benefits accruing from modern methods of conducting an operation are so constantly in evidence that their discussion at this time seems trite. Yet it is only by keeping them in view that tentative suggestions in new fields can eventuate in things accomplished. Therefore only would I allude to the safety to life and limb with which compound fractures are now treated. A death following a compound fracture from wound infection is now a *rara avis*, even in hospital wards that are far from surgically clean. Barring the paramount danger of infection and its sequel, necrosis, there are factors which would render the prognosis as to restitution to the normal in compound fractures quite as good, if not better, than in those uncomplicated by a broken skin. The directness by which fragments can be moulded into position, and retained by sutures if need be, the ease with which intervening muscle or membrane can be removed, and the certainty with which an hæmatoma can be avoided at the site of injury, are data which, were it not for the danger of infection, would make the greater almost to be preferred to the lesser injury. So has the treatment of compound fractures been bettered by the grace of modern methods. In the absence of a like positive influence in the treatment of simple fractures, the results here obtained on the whole are much as they were in the three decades intervening between the introduction of anæsthesia and of antiseptic surgery. Except in fractures of the simplest varieties, we share with our predecessors the

anxieties from incomplete reduction, deformity, shortening, and of partial or incomplete ankylosis in articular or pararticular fractures. In regard to these, as a class, indeed, only two steps in advance have been taken, and one of these is in the nature of a don't. There is a unanimity of opinion that by prolonged immobilization joint function is jeopardized. To effect the best functional use of a joint, "there must be a proper balance between rest and motion; rest of the broken bone, motion of the joint muscles, tendons, fascia. But even the methods to these ends are the subject of much controversy." This is one step. The other, a very decided advance, has been made in the method of overcoming shortening in exceptional cases by tenomyotomy. Its range of utility has been widespread since Diffenbach first divided the triceps for fracture of the olecranon. Division of the tendo-Achilles, the hamstring tendons, and of the sterno-cleido mastoid may be done when it is evident that muscular contraction alone is responsible for the shortening or deformity. In this connection it is amusing, by way of contrast, to quote from Ricard on *Fractures*. In 1890 he wrote, "it is useless to add that to-day no one has recourse to tenotomy; not on account of the terrible mortality which Malgaigne had forty years ago, three deaths in five cases, but because tenotomy has become superfluous since anæsthesia and continuous extension are used in the overcoming of muscular contractions."

Cases are encountered in which anæsthesia, extension and tenotomy combined will fail to reduce deformity, and in which we seem helpless to prevent an unsatisfactory result. Aside from fractures of the patella and of the femoral neck, wherein anatomical data for bony union are deficient, we are wont at times to see results far from good in fracture of the lower end of the tibia, of the femoral shaft, of the lower epiphysis, of the femur, of the radius, of the elbow, and of the clavicle. The use of the cathode ray, where feasible, will doubtless tend to lessen the frequency and extent of post-fracture deformities by making easier the apposition of fragments. Yet will there be cases in which a clear picture of the lines of fracture will avail but little or nothing in the therapy. The interposition of

muscle, ligament, or fascia, or of a loose fragment of bone in the line of fracture will at times prevent its reduction, and from the very beginning forbode a result dreaded in proportion to the deformity entailed and its ensuing limitations of motion. In view of the successes now almost uniformly achieved in elective operations on the bones and joints, the question might well be discussed whether in otherwise irreducible simple fractures early operative intervention should be refrained from. Such has been the surgical teaching of the past.

Even very recent writers are silent upon the subject, and the consultant would find little or no justification in converting a recent subcutaneous fracture into an open one to obtain a permanent better result. Nevertheless, individual points have been made in this direction. By Senn, in the direct fixation of fragments in injuries of the hip, by McBurney in fracture of the humerus complicated by dislocation, and very recently by J. W. Hearn (reported by Spencer) in the suturing of the broken clavicle. The unique position in the immediate operative therapy of fractures is occupied by the patella, fractures of which have often enough been united to render a verdict against immediate interference. Since it was my privilege, in 1891, to see Schede overcome a four-inch shortening of the femur from oblique fracture six months after the injury, I have believed that in certain cases an interference before the union had resulted would be preferable to the certainty of deformity. The cases in which operation would be indicated are necessarily few. Nevertheless, seven cases have come under my observation in which the fracture is exposed and directly treated. I beg to submit brief histories of these cases:

William F., aged twenty-four years, single, German; beer-wagon driver. Admitted to the Good Samaritan Hospital May 1, 1892.

Diagnosis. Fracture of the lower end of the right tibia. In jumping to keep a brick wall from falling upon him he landed full on his feet, but his right ankle turned, producing a fracture of the lower end of the tibia. The condition presented made the exact nature of the lesion difficult to determine. There was a very extensive hæmatoma about the ankle, very great widening of the joint, with crepitus easily

felt. Under the extensor tendons below the line of the joint, surrounded by an hæmatoma, could be felt the loose fragment, which seemed to have the shape of the articular portion of the astragalus. Under anæsthesia every effort was made to bring this portion of bone into its normal relation between the tibia and fibula, but without success. A long anterior incision was, therefore, made over the joint, and the loose piece of bone removed. It proved to be the outer portion of the tibia. It was pyramidal in shape, and the base was covered with cartilage. It measured an inch and a half in length and half an inch in thickness at its widest part, and evidently came from the articular end of the bone. Except for a small strip it was entirely detached. Through the incision the fracture of the lower end of the fibula was recognized. All clots having been removed, deep sutures were resorted to, the external wound partly filled with gauze and retentive dressings applied. The first dressing remained in position ten days, and when it was removed showed the wound was dry. Second dressing applied on the twentieth day. When this was removed on the thirtieth day the joint was freely movable, and the splints were left off except at night.

June 14th. The splints were finally left off, and the patient enabled to bear the weight upon the foot. Only slight impairment of ankle movement.

20th. Patient discharged well, walking without crutch or cane.

Case II.—John H., aged six years. Reported with permission of Dr. Krouse, in whose service the case occurred. November 19, 1895, patient was thrown from a street car, sustaining a compound comminuted fracture of the right leg, and what at first seemed to be an insignificant injury of the lower portion of the left thigh. There was a good deal of contusion here, and quite an extensive hæmatoma. The condition of the right leg necessitated immediate amputation below the knee. During the recovery from the amputation, which did not unite by first intention, the hæmatoma in the lower portion of the left thigh disappeared, and revealed an epiphyseal separation at the lower end of the femur. It was evident that the epiphysis was tilted upward and forward, and that the lower end of the shaft was protruding into the popliteal space, where part of its lower square surface could be clearly mapped out. The leg was contained in flexion with weight extension, in the hope of reducing the dislocation. The general condition of the patient did not justify an operative interference until on December 30th, when an open incision was determined upon.

An incision about three inches in length made in the line of the popliteal space very readily exposed the transverse line of separation. The square surface of the shaft, without any adherent cartilage, was readily made bare. The upper surface of the epiphysis with its cartilaginous covering, to which the cartilaginous disk adhered firmly, had been tilted forward, so that it was found to rest against the anterior surface of the upper fragment. Callous had not been thrown out. Extension failed to relieve the dislocation, even after the division of the nearest hamstring tendon. It was only after half an inch or more of the lower end of the femoral shaft had been chiselled away, that the epiphysis could be tilted on its axis to a degree permitting approximation of the surfaces. After hæmostasis had been cared for, the wonnd was tightly closed except for silkworm-gut drainage. The leg was dressed in right-angle flexion.

During seven days after the operation it appeared as though primary union would result. This, however, was not accomplished, for the evidences of infection were seen on the ninth day, when the dressings were changed. Stitches had to be removed, since there was some suppuration.

The subsequent history of the case was that of ordinary infected compound fractures. The suppuration, which was at first extensive, gradually subsided, and that without necrosis. The patient was admitted to the Jewish Hospital on November 19, 1895, and remained in the institution until May 29, 1896, when he was finally discharged well.

This patient attends school regularly. In its growth the femur has kept pace with its fellow on the opposite side, although a sinus has formed which, I have been informed, leads to a small sequestrum.

Case III.—H. P., Jewish Hospital, June 5, 1892. Male, aged forty-three years. Sustained a fracture of the right radius six weeks before admission. There are characteristic silver-fork deformities and radical abduction. The fingers are flexed, while extension of the fingers and wrist is limited. Pararticular firm œdema is very marked. During two days the arm and hand were retained in suspension to reduce the swelling. It was then evident that reduction had not been accomplished, although a large callous had been thrown out. The dorsal prominence of the lower fragment was very decided.

Operation June 6th. An incision three inches in length was made from the outer border of the radius between the extension muscles of the thumb down to the bone. The periosteum was readily lifted from the callous. This was sponged and easily removed with saw and chisel, thereby clearly exposing the line of fracture. No evidence of impaction was found. Efforts at reduction failed until the bone was transversely divided with the chisel in the line of fracture. A reduction was then easily accomplished, and the fragments retained in place. The wound was closed except for a small gauze drainage to care for the rather copious oozing. The arm was suspended during the first twenty-four hours after the operation.

The subsequent history was uneventful. After three weeks all dressings were dispensed with and motion instituted. A supra-articular line of tenderness could be discovered, but there was no deformity. When the patient left the hospital, six weeks after operation, wrist movement was somewhat limited in dorsal flexion, and there was a slight limitation of extension movements at the terminal digital phalanges. For all ordinary purposes the range and strength of motion of the fingers in flexion were normal.

Case IV.—R. S., aged sixteen years. Good Samaritan Hospital, July 6th, 1893. Four weeks ago, from a fall, patient sustained a fracture of the right radius. Efforts were made in the country, where the accident occurred, to reduce the dislocation, but evidently without success. Splints had been used almost continuously since the accident. The arm presented the typical deformity of a Colles fracture, with impairment of motion in the thumb, index and middle fingers, due to binding down of the tendons within the tendon sheaths. Point pressure over the site of the fracture was exceedingly painful. Under anæthesia an effort was made to reduce the dislocation, but without success. An incision was, therefore, made along the outer border of the radius, three inches in length, and the fracture thoroughly exposed. There was no attempt at union. The line of fracture was readily discerned and an impaction easily recognized. It was only after the bone was divided in this line with the chisel that reduction could be effected and the deformity readily removed. The entire wound was closed without drainage, and the recovery was an uneventful one. Passive movements were commenced two weeks after the operation. The patient was discharged from the hospital six weeks after the operation, with practically normal function of the wrist and finger movements.

Case V.—R. F., aged nine years. Family history good; admitted

to the Jewish Hospital December 26, 1895. On September 25th was run over by a bicycle, and the right femur fractured a little below its middle. The fracture was very oblique, and shortening two and one-half inches. In the very beginning the case was treated with weight extension and lateral splints. Efforts at reduction made a week after the accident, under anæsthesia, failed to reduce the shortening. After six weeks the union was quite firm, with marked outward bowing. Shortening between two and one-half and three inches.

Operation January 2, 1896. Incision five inches in length from the outer portion of the thigh over site of fracture. Hæmatoma had entirely disappeared. The fracture is very oblique. The fragments which had passed each other were united by a bridge of new bone. With considerable difficulty this was severed with the chisel. The nodular cavity of the upper fragment was closed by callous, the lower was still open. The upper fragment was freshened by the saw. Senn bone ferrule, largest size, was now introduced, and the fragments brought into good position. Silkworm-gut was resorted to, except for which the wound was tightly closed. A final recovery from the operation in this case was satisfactory in the extreme. Except during the first three days the temperature did not exceed 101°, after which it returned to the normal, and continued so throughout the stay at the hospital. A fenestrated plaster-of-Paris dressing was applied immediately after the operation, remaining in place six weeks. The patient left the hospital with the wound perfectly healed, on the 1st of March 1896. After he left the hospital some pressure necrosis from the ferrule resulted. This was removed by Dr. E. W. Walker. The patient now, I understand, has a shortening of less than one inch, and walks with only a perceptible limp.

Case VI.—G. M., aged thirty three years, admitted to the Cincinnati Hospital May 12, 1896. Patient was in the hospital a year ago for delirium tremens. On the day of admission was run over by a stone wagon, sustaining fracture of the leg.

Physical examination reveals a fracture of both bones of the right leg midway between ankle- and knee-joint. At the site of fracture there is a well-marked angle with outward opening. The foot itself is inverted, toes pointing toward arch of opposite foot. Very considerable hæmatoma at the site of fracture.

Under anæsthesia efforts at reduction were made. It is evident that a loose fragment intervened at the site of fracture, preventing reduction. Dr. Evans assisted.

Under A. C. E. anæsthesia an incision three inches in length was made over the site of the fracture, from which a large quantity of blood exuded. When the fracture was thoroughly exposed a spiculum of bone, a third of an inch wide and over an inch in length, was found wedged between the main fragments, which could not be brought into apposition until the intervening spiculum was removed. Reduction was then easily accomplished. The entire wound was tightly closed in the hope that primary union would result. This was evidently a mistake, for suppuration ensued within a week, necessitating the removal of the stitches. Some necrosis of the bone resulted, so that on July 18th a secondary operation with bone sutures had to be made.

The patient was finally discharged with a sound leg, walking without cane and with less than an inch shortening.

CASE VII.—A. P., aged thirty-eight years, admitted to the Cincinnati Hospital, December 22, 1896.

Present history. On date of admission patient received a gunshot-wound of the forehead and left arm. When admitted she had recovered from shock. There was considerable hemorrhage from wound in the forehead, and she was unable to use the left arm. The wound of the forehead was a scalp wound and of no significance. On the outer side of the left arm about two inches below the acromion process was found the wound of entrance, probably made by a 38-calibre ball. Crepitus is felt if the arm is moved and the head does not rotate with the shaft. An aseptic dressing was applied and external splints over extension. Both wound in the scalp and in the arm healed by first intention.

January 16th No evidence of union in the fractured humerus. A radiograph taken shows an oblique fracture about four inches below the shoulder-joint, with the lower fragment passing upward along the outer surface of the upper The bullet is seen flattened against the inner side of the upper fragment, having evidently passed through the humerus.

18th. Under chloroform anæsthesia an incision three inches long made along the outer surface of the arm, by which the fracture was exposed. Between the fractured surfaces an unorganized blood clot adherent to shreds of periosteum was found and readily removed with curette. The bullet was removed. When extension was applied the fragments were easily brought into apposition and retained by a wire suture. The wound was entirely closed by deep and superficial sutures.

The subsequent history showed an infection, which was limited to

the soft parts and was readily relieved by removing a few of the sutures. The patient was discharged on March 3d. The bone had united by a large mass of callous; arm function practically normal.

Remarks. The number of cases reported, though small, is of sufficient diversity in regard to regional distribution and time of interference to warrant some general conclusions.

In two of the cases interference was immediate and in two osseous union had occurred. In one of the cases of immediate operation suppuration resulted, whereas in the other complete primary union took place. In only two of the cases in which operative interference was delayed did suppuration result. The inference may possibly be drawn herefrom that early interference predisposes to infection. This can readily be explained by the lowered vitality of the contused tissues and their notably reduced resistance to infective processes. This inference is strengthened by reports from many surgeons who have resorted to direct mechanical appliances for fixation of fragments in compound fractures or for the cure of pseudarthroses. I would only refer to the cases in which Senn used the bone ferrule and Bircher the ivory plug. Nevertheless, since in all these cases, by the interference plus the infection, the end result was better than it would probably have been without operation, the patients were brought only into the condition of one who had primarily sustained a compound fracture.

The lesson is plain, however, that extraordinary precautions toward securing asepsis must be taken before the simple is deliberately converted into a compound fracture.

Of fractures through the epiphysis two cases are recorded, one of the lower end of the radius, the other of the femur. Both of these were operated upon before callous had been thrown out.

In two cases operation was delayed until quite firm union had been effected. The operations were therefore for vicious union. Although nature does much to cover the inequalities left from the fracture, in neither of these cases would a good result have been obtained without operation. The question is,

therefore, pertinent, if when deformity is certain to follow fracture, it is not better to wait until union has taken place. Aside from the doubtless greater danger from infection in immediate operations, no strong argument can be advanced in favor of delay. Particularly is this true in epiphyseal separations. In those of the lower end of the femur the danger to limb and even to life from the compression of the vessels is very great. An early interference can only be of advantage whereby the production of deforming callous will be forestalled. The technical difficulties of operation before callous has formed are very much less than those which attend the operative corrections of vicious union after fracture. Such fixation of epiphyseal separation need not necessarily imply an open wound, since by means of long pins driven through the skin, Helfferich has recently succeeded in fixing the humeral epiphysis. The same procedure was employed several years before by Lange, and the principle is that advocated by Senn in fractures about the hip. It is very possible that by means of such a drill and with skiagraphic tracing of the fracture, say of the elbow or of the ankle, before him, an operator can transfix fragments without open incision and retain them in position by means of the drill.

There are certain classes of cases in which open treatment should be strictly ruled out, even if the deformity is great. In cases of crushed fracture, where extensive comminution can be made out, nothing could be gained from operative interfence. Altogether, therefore, the cases in which the open treatment should be resorted to would be few and far between. Nor does the experience of the writer, or what he has gleaned from literature, warrant him in coming to conclusions that are final. Nevertheless, he believes that it would be justifiable to submit in a tentative way the following postulates:

1. The conversion of a simple fracture is justifiable when other means to secure the best end result fail.

2. In fractures of the diaphysis of the tibia, femur, humerus, and clavicle, in which insurmountable longitudinal displacement or axial rotation has taken place, immediate operation, or mediate operation before definite union has occurred, is indicated.

3. In epiphyseal separations, when reduction cannot be otherwise effected, an early operation is justified.

4. Fractures complicated with dislocations irreducible by other methods warrant operative interference.

5. The involvement of a joint, except probably in the case of knee and hip, do not, *per se*, militate against operation if this is otherwise indicated.

6. If extensive comminution is present, as in compression or crushed fracture, operation is contraindicated.

7. Special precautions against infection must be taken, in connection with which should be borne in mind the dangers of too firmly closing a wound and the advantages of temporary tamponade and secondary suture.

8. Reckless and indiscriminate resort to the operative relief of deformity in recent simple fractures is to be condemned, since there would be few fields of surgery, in the event of an unsuccessful intervention, in which the contrast could be greater between the good intended and the harm done.

EPIPHYSEAL SEPARATION OF THE HEAD OF THE FEMUR, WITH REPORT OF A CASE.

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My excuse for presenting this paper, if such is needed, is that I may bring before this meeting a subject which in itself may appear insignificant and unimportant; nevertheless, I feel assured that there is much in the subject which must interest and instruct us in dealing with joint injuries in persons who have not reached maturity. Before considering the special epiphyses under consideration, let us glance for a few minutes at the general subject of epiphyseal separations.

This is regarded by the majority of surgical writers as a rare injury, but careful observation among a class of patients where the accident is possible leads one to believe that many cases are not recognized as such in the proper sense, and are regarded as fractures about or into a joint. The importance of careful recognition make this accident worthy of special study.

Separation of the epiphysis is even more important than fracture. Its occurrence in early life and the important effect which may ensue make it worthy of special study. The frequent error in diagnosis which separation of certain epiphyses has caused may be attributed possibly to insufficient and inexact teaching on the subject in many of the text-books on surgery.

Complete separation of an epiphysis is usually accompanied by a much greater stripping off of the periosteum from the shaft of the bone than is ordinarily found in a simple fracture, hence the greater tendency of such injuries to be followed by suppuration and necrosis and, during repair, of an excess of callus

which may in itself interfere greatly with the function of the joint.

In many instances a detachment of the epiphysis implies an injury to the joint which it helps to form—*e. g.*, in the lower end of the humerus and the head of the femur.

Much difficulty is experienced in replacing and retaining certain epiphyses in position after separation, a difficulty which is rare in dealing with fractures of the shafts of the bone.

Careful study of a bone taken from a young subject is both interesting and instructive. The knowledge of its growth and development makes clear what otherwise might be imperfectly understood. It will be noticed that the periosteum at the epiphyseal attachment is, as a rule, much thicker where it is attached to the cartilaginous disk, and partakes more of the character of a ligament. This anatomical fact will explain why so much more bone is often denuded of its periosteum than occurs in simple fracture—the thicker and denser the periosteum, the more likely it is to strip off *en masse*, as we have seen it do in compound separations of the lower end of the femur, where almost one-half of the shaft of the femur was divested of its periosteum. The ligamentous character of the periosteum is often its strongest bond of union between the diaphysis and the epiphysis. It has been shown in the small epiphysis of the head of the femur, where the periosteum was divided circularly, that one-fifth of the amount of force will suffice to detach the epiphysis which would be required under other circumstances. It has been observed in the great majority of cases that the cartilaginous disk is adherent to the epiphysis. This is again verified, first, by the experiments of Hutchinson on animals, where, upon examining and making sections through the epiphysis, it was noticed that the arrangements of the trabeculæ were much stronger and better marked on the epiphyseal side of the disk, so that on separation it will invariably be found adhering to the epiphysis.

The delicate attachment of the epiphyseal disk would lead one to expect that either the violence necessary to detach, or the reaction attending subsequent body union, would be suffi-

cient to obliterate it and check its further development. Fortunately, this is not always the case, as the disks show a remarkable power of resistance. If this were the case, Ogston's operation for the correction of genu valgum would have fallen into disuse much sooner than it has. On the other hand, it must be remembered that arrest of growth is a fairly frequent result of epiphyseal separation, and particularly so if the latter remains displaced and only conneeted by the periosteal new bone to the diaphysis. The arrest of development after epiphyseal separation is most disastrous when it affects only one bone of either forearm or leg. The main difficulty in the reduction of the epiphysis after separation is due principally to the position of the soft parts, especially the sleeve of the periosteum, through which the diaphysis has been forced, thus preventing reduction.

It is most important to effect reduction as soon as possible, as the rapid occurrence or swelling will make the diagnosis and the reduction more difficult. The connecting bridge of the periosteum soon thickens and shortens, in a few days rendering reduction impossible. Therefore, the more prompt the reduction, the less will be the risk of exuberant callus or of interference with the growth, and possibly of suppuration or necrosis. From what has thus far been stated, early and accurate replacement of the bone, with careful avoidance of rough manipulation, and with the application of cold to check all inflammation, is incumbent on the surgeon in dealing with these injuries. The stripping off of the periosteum from the shaft, which occurs with some displacements, is extraordinary in extent, and by some much importance has been attached to this periosteal stripping as the chief factor in producing suppuration.

The tendency of some epiphyses after separation to undergo suppuration is very marked, and it would appear from analyzing a large number of reported cases that those epiphyses which are most active in carrying the nutritive forces — *e. g.*, the epiphysis in relation to the shoulder, wrist, and knee, are most liable to be thus affected, because we find that the principal growth or development takes place at the shoulder

and wrist in the upper extremity and at the knee in the lower extremity.

The number of cases of epiphyseal separation reported of the upper end of the femur is few, and in some of these the diagnosis is by no means assured. That such an accident is possible, and does happen at times, cannot be denied, although I question if there is a human specimen in any of our museums that bears out my statement. The reason for this is that the accident does not occur in injuries which produce death. Only in one case, that of Bousseau,[1] the patient, aged fifteen years, was run over by a cart. After death from shock, it was found that the capsule of the left hip was opened and the epiphysis of the head separated at the exact epiphyseal line. This injury has been long recognized by veterinarians, and many specimens can be found which illustrate the character of this injury. Mr. Hutchinson, Sr.,[2] states that he has obtained several specimens from the lower animals resulting from violence in attempting sexual connection, and that it is an accident pig breeders are familiar with, knowing that it is dangerous to put a heavy boar to a sow which has not attained her growth. These cases are important in the comparative absence of facts illustrating such accidents in man, since they prove that under certain conditions the epiphysis in question may without much difficulty become detached. If it is remembered how closely and accurately the head of the femur is fitted into the acetabulum, it can be easily seen how *favorable* the conditions are for detachment of this epiphyseal head. It may, indeed, be more easily detached than the head of the humerus, which we know is quite common. In all probability it is the length and inclination of the femur which saves the epiphyseal line in the femur by transmitting the force to other parts.

We may assume that the three accidents most liable to occur are fracture of the neck of the femur, dislocation and separation of the neck from the head at the acetabular margin. The latter injury would in our present light appear to be most likely to

[1] Les Bull. de la Soc. Anat., 1867, p. 283. [2] Arch. Surg., vol. iii. p. 290.

occur in young subjects under twenty years of age. Although all three of these accidents are possible, separation of the epiphysis in the recent state is most likely to present symptoms of dislocation, and if the patient is under twenty years of age, a detached epiphysis may be suspected. I cannot but feel that many obscure injuries about the hip-joint can much better be explained and accounted for by this injury than in any other way. The study of the growing bone is both interesting and instructive, and an accurate knowledge of its growth and development helps us to understand much better its ability to receive and transmit forces.

The upper end of the femur is developed from three distinct centres: one for the head, which appears about the first year, one for the great trochanter, appearing about the fifth year, and the lesser trochanter, about the fifteenth year, uniting to the shaft in the reverse order of the appearance of their ossified nuclei, so that we find the head uniting to the shaft about the twentieth year.

This much surmised, we may now consider the question of symptoms and diagnosis. Pain has always been recognized as one of the symptoms of fracture, and is also noticeable in detachments of the epiphysis, although it, as a rule, is distinctly less than when two bony surfaces are drawn past each other, as in the attempt to elicit crepitus.

Crepitus. This sign is always of great assistance in confirming diagnosis, but in true separation it is never very marked, and when recognized is of a doughy character, or as if the joint surfaces were in contact. Sometimes rough grating may be felt, depending altogether on the positions the bones happen to assume.

Shortening, according to Tubby, amounts to about three-fourths of an inch, although it may be more. The symptom of shortening may be slightly misleading, as it is very easily overcome by a very slight extension of the limb (as was noticed in my case cited) which gradually reappears. In this respect, the spasmodic muscular contraction, noticeable in fracture of the neck, is distinctly absent.

Eversion, if present, is always a distinctive sign of injury to the neck of the femur, so characteristic of similar injury in adults.

Mobility. The movement of the joint would naturally be increased, as there is less muscular rigidity than in simple fracture of the neck, and the movements in which the ligamentum teres is made tense—*e. g.*, external rotation and adduction in the flexed position; therefore these movements would be exaggerated.

Deformity. This is usually in proportion to the amount of shortening, causing the neck of the thigh to be carried up on to the margin of the acetabulum, thereby increasing the distance from the median line to the trochanter. In comparing the trochanters of the injured side, it will be found above its normal level, and also above Nélaton's line. All of these symptoms may be masked by swelling and ecchymosis.

Diagnosis. This injury is likely to be mistaken for dislocation or fracture of the neck within the capsule. In the former injury the characteristic signs of dislocation will be present, and in a careful survey of the joint is hardly to be mistaken. The injury with which it is most likely to be confused is a fracture within the capsule, and there are but two points which will aid in differentiating this injury; the age of the patient, intercapsular fracture rarely being under fifty years, and epiphyseal separation necessarily must occur under the twentieth year, and this line being a weak spot in the neck, it is more reasonable to expect separation than fracture on the stronger tissues on either side. Yet, exceptions to this may be found, as in Mr. Hutchinson's comparisons of epiphyseal separation to the tearing of postage stamps. In the latter the weakened place is undoubtedly the perforated line, but in spite of this, unless care is used, the stamp may itself be torn. In obscure cases the use of the Roentgen-ray may aid in confirming the diagnosis, although in my case no aid was derived from its use.

Fracture of the pelvis, especiplly of the margin of the acetabulum, may be mistaken for a detached epiphysis, but in fracture of the acetabulum possible dislocation of the hip is liable to occur.

Mr. Hutchinson,[1] in a clinical lecture on the diagnosis of injuries about the hip-joint, laid down certain general rules to be pursued in the examination of obscure cases:

1. Always use an anæsthetic.

2. Do not be misled by the patient's statement as to what can be accomplished by the injured limb as to the belief that he has not sustained a serious injury, as patients with dislocation are sometimes able to walk, as also in impacted intercapsular fracture. The same may be possible in epiphyseal separation where the capsular ligament is not ruptured.

3. In dislocation the range of motion is decreased, in fracture it is increased, but may be modified by impaction or muscular rigidity.

4. The age of the patient and the character of the injury.

5. Eversion being the rule in fracture and epiphyseal separation, and inversion in dislocation, occasionally this deformity is seen in fracture.

Treatment. The indications to be met with are similar to those laid down for dealing with fracture of the neck of the femur—*e. g.*, a firm solid mattress, with weight, extension and long lateral splints, with bran or junk bags, which give better support over the head and trochanter. Shortening here is not so important, so far as the growth of the limb is concerned, as most of the growth takes place at the lower epiphysis of the femur and the upper epiphysis of the tibia. Shortening, nevertheless, means imperfect approximation of the diaphysis and epiphysis, whereas, if union takes place, impairment of the joint function will result. The time required will, as a rule, I think, be longer than for the repair of a simple fracture. The extension should be kept up for at least five to six weeks, and rest in bed for several weeks longer. After the removal of the weights, slight passive movements should be begun, and then the patient allowed to walk with the aid of crutches. In young subjects extension should be carefully watched, as the constant weight on one leg will sometimes tend to produce lateral curvature of the spine.

[1] Med. Times and Gaz., 1886, vol. i. p. 194.

Results. Bony union with good motion and little shortening after epiphyseal separation of the head of the femur is of course the ideal result, and theoretically it would be accomplished if all conditions were favorable; but, unfortunately, the character of the injury varies so in different cases, where the physical signs are almost identical, that a most guarded prognosis should be given. It would seem that the stripping of the periosteum from the neck of the femur, and new periosteal outgrowths which are so prone to follow, must be factors tending to limit joint motion. In a case of old epiphyseal separation of the end of the femur which I had the privilege of examining in the wards of the Philadelphia Hospital, through the courtesy of Dr. Barton, the most pronounced remaining symptoms were the undue prominence of the trochanter, with one and one-half inches shortening, impairment of motion, which appeared to be principally intensified by a number of osteophytes or periosteal new growths around the joint, and a distinct limp in walking. In my own case, the history of which is taken from the Resident Physician's notes, the facts are as follows:

Robert C., aged fifteen years, was admitted into the wards of the Episcopal Hospital on December 28, 1896. He was a boy of fair physical development, but his mental condition was distinctly impaired. His mother states that he slipped on the ice while walking, striking his hip (trochanter); was carried into the house and was unable to walk. Several days later was admitted to the hospital. On admission there was an inability to stand and bear weight on the injured limb, and with some tenderness over the region of the hip. On laying him on his back in bed and placing the two legs together, with moderate extension, the shortening disappeared so thoroughly that at first I was disposed to consider it simply as a contusion of the hip, as all the movements could be performed almost without pain and with little embarrassment of motion.

On the following day there was again marked deformity, with about one inch shortening, and some prominence of the trochanter; no eversion of the foot, though it could be everted beyond the normal point with pressure on the inner side of the foot. Inversion could be equally performed. The patient was etherized. All of the natural

movements of the joint could be exaggerated. The trochanter could be rotated more than on the sound side, but without any apparent diminution in its arc. No distinct crepitus could be elicited, although some slight rubbing could be detected as though two rough cartilaginous surfaces were brought in contact. Feeling that my diagnosis of separation of the epiphyseal head was not positive, I again had the patient etherized, and with my colleague, Dr. H. C. Deaver, I again went carefully over the case, with the same result. Believing that the neck of the femur was separated at the epiphyseal line, I had a skiagraph taken but with indifferent result. The patient was placed in bed, with weight, extension, and sandbags for lateral support.

On February 9th extension was removed with apparently good union, and measurements showed no difference in the length of the legs, and the patient was soon permitted to leave his bed. Owing to his rather impaired mental condition, he acquired the art of walking slowly, leaving the hospital soon at the request of his parents.

Four months after the receipt of the injury I had an opportunity to again examine the patient. He walked with a slight limp and with the aid of a cane. On measuring the injured limb, there was found to be a shortening of about one inch. The movements of the injured limb were slightly embarrassed, apparently unaccompained with pain; no eversion of foot, although it could be everted beyond normal; it could be equally inverted; the thigh could be flexed, without tilting the pelvis, to about forty-five degrees; no roughening on motion about the joint; the joint functions apparently were performed without friction; fair abduction without tilting of the pelvis, of about two and one-half feet from the median line; the upper margin of the trochanter slightly above Nélaton's line; also prominence of trochanter increased about three-quarters of an inch; distinct depression behind the trochanter. There was some flattening of the muscles of the buttock and disappearance of the rima-natium. The muscles of the injured limb were equally nourished with the opposite side. Another attempt was made to have the joint skiagraphed, but the results obtained were not satisfactory.

SYMPTOMS AND TREATMENT OF HEPATIC ABSCESS.

With Report of Eighteen Cases.

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On account of the obscurity of symptoms in a considerable number of hepatic abscesses, and the difficulty in properly valuing those which are present, I have found it worth while to formulate those which I have most frequently seen and upon which I have mainly relied for diagnosis.

A searching and accurate history should be elicited in every suspected case, and taken with a special reference to previous attacks of dysentery, diarrhœa, intestinal ulceration, gallstones, inflammation of portal-vein region, typhoid fever, post-cæcal inflammation, intemperance, gluttony, syphilis, trauma, and chill.

The etiology of the disease is sufficiently distinct to enable us to say that these are the predisposing and exciting causes of hepatic abscess. Although many cases occur in which the etiological factor is either so obscure or so far removed from the onset of the symptoms as to throw doubt on its validity, yet in the main, diligent search will reveal the true cause.

Symptoms may, for convenience of description, be divided into subjective and objective. Of these the subjective are usually the first to appear, and shall, therefore, be first considered.

Pain in the region of the liver is ordinarily an early and prominent symptom. Its exact location will be determined by the position of the forming abscesses—*i.e.*, in the right or left lobe, on the upper or lower surface. It is usually constant from the onset, and radiates backward and to the right shoulder. Its

degree depends somewhat on the situation of the abscess and the rapidity with which it develops. Those which are deep-seated cause less acute suffering, the pain being of a dull, aching kind, than those which more nearly approach the surface, and thereby provoke perihepatitis. When perihepatitis exists pain is much intensified, and the presence of acute pain generally betokens the advance of the inflammatory process toward the surface of the liver. By carefully noting the exact limits of pain and tenderness, we may often locate the abscess with exactness. In such as are on the under surface, or to the front of the organ (right lobe), the pain will be greatest just behind the free border of the ribs, and will be increased by upward pressure on the liver. Where the abscess is located on the upper surface pain will be felt most keenly at the upper part of the liver, and will be increased by pointed pressure made through the sixth, seventh, and eighth intercostal spaces. Here the respiratory movements augment pain, and so pronounced is this that in some cases hepatic abscess on the upper surface has been mistaken for pleurisy. When the abscess is centrally located, and no perihepatitis exists, pain is less prominent. In any case pain tends to radiate backward and to the right shoulder, but this is most marked in those cases where the abscess is upon the upper surface. Pain is increased by movements of any kind, especially such as jar or jolt the body. The pressure of bands or bed clothing is sometimes unbearable. Sneezing, or coughing, or straining at stool will often cause great suffering. Muscular pressure or an unfavorable posture will often provoke pain, as lying flat upon the back with the lower limbs extended, or upon the left side, if the abscess is in the right lobe. This is particularly true of large and rapidly forming abscesses, or when much perihepatitis is present. Frequently the sharp pain induced by the movement of the liver in the respiratory act greatly restricts breathing and provokes dyspnœa. Pain is in every case increased by digital pressure.

Nervous manifestations are rather common. Profound depression and lassitude come on early, and are out of proportion to the apparent gravity of the disease. Insomnia may be an en-

during symptom. Great restlessness, with headache, characterizes some cases, and is accompanied by unnatural irritability and peevishness of temper. In some persons, particularly in cases where the more acute symptoms have somewhat abated, lethargy and somnolence supervene. In cases where the abscess is upon the upper surface, a dry irritating, intractable cough exists. The recumbent posture increases the cough, which is somewhat diminished by elevating the body or assuming a sitting attitude.

Digestive Disturbances. Loss of appetite appears early, and in most instances is complete, there being absolute aversion to food. In others the appetite is perverted with a peculiar craving for acid drinks, sour fruits, or succulent vegetables; thirst is usually much exaggerated; the breath frequently becomes fetid. There is eructation of gas, and sometimes of acid fluids; nausea is a variable symptom; it is never constant, yet all cases suffer with it to a greater or less extent, and occasionally it is prominent. Vomiting will be observed in a fairly large proportion of cases, taking place usually soon after the ingestion of food. The vomitus is generally composed of bile-stained mucous. Diarrhœa may be present and persist throughout, or constipation of an obstinate character exist. In a few cases these opposite conditions will alternate. A bitter, slimy taste in the mouth is conspicuous. The teeth are foul and thin, pale sordes form on them. The tongue varies much in appearance; occasionally it is fiery red, like raw meat, sometimes it appears denuded and glazed, again it is heavily coated with a yellowish-white fur resembing a smear of custard. When it is thus coated, the margin and tip are usually free and red. The coating is rarely brown and dry, except in such cases as run a so-called typhoid course. Digestive disturbances are more surely present, and are more distinct in the cases where the abscess is situated on the under surface of the liver.

The most invariable objective symptom is the enlargement of the liver. This is rendered obvious by a bulging of the right hypochondrium. Enlargement may take place in any direction, this being determined by the position of the abscess. If cen-

trally located, the enlargement is in all directions. When nearer the surface, expansion follows the line of least resistance. Therefore, those upon the lower surface extend downward and toward the umbilicus. Those upon the diaphragmatic surface increase upward. Hence the direction of increase in liver dulness usually indicates the location of the abscess. With an increase in the bulk of the liver, especially if it takes place upward, the boundary between lung and liver is displaced upward, the displacement being usually quite convex, and there is lessened mobility of this boundary line in breathing or assuming the left-side posture. The tumor may project so far downward that its lower border can be distinctly felt, and the respiratory movements of the liver discerned. The inferior intercostal spaces are usually obliterated, indeed, may even protrude. There is pronounced muscular rigidity over the affected region, particularly noticeably in the right rectus.

When accessible to palpation the tumor appears hard, smooth, and elastic. Fluctuation, when present—unhappily it is seldom seen—is a most valuable symptom, but is only demonstrable when the abdominal walls are unusually thin and relaxed, the tumor projecting forward and downward, the abscess walls attenuated, and the contents quite fluid. Perihepatic friction is as rare as fluctuation.

Locally the skin is not changed, except to appear tense over the swollen parts, and to assume a reddish, œdematous aspect in those cases in which adhesions have formed between the liver and abdominal wall. Redness and œdema appear more quickly in lean subjects than in fat ones. This appearance of the skin *generally* denotes formation of adhesions, but is not an *invariable* sign of their presence.

Although actual jaundice never exists except in those instances where the abscess by pressure, either partially or completely occludes the common bile duct, or where catarrh of the ducts coexists, yet the skin assumes a yellow pallor that is quite characteristic. It also becomes contracted, harsh and rough, and is frequently bathed in profuse and irregular sweats. Hectic is pronounced. Rigors, shivering and actual chills appear frequently

and at irregular intervals. High temperature, with flushed cheeks and rapid breathing follows, and passes off in copious sweats.

The posture of the victim of hepatic abscess is almost characteristic. Every unconscious endeavor is used to relieve pressure and weight. The right side decubitus is maintained in those cases where the abscess is near the front or on the under surface of the organ. If upon the diaphragmatic surface, the body will be raised on several pillows and inclined or tilted to the right. A small pillow or cushion tucked under the affected side is a common sight. The thighs are flexed on the abdomen, and every movement is executed with great care and deliberation.

Emaciation is a conspicuous feature of the disease. Destruction of fat starts early, and is rapidly progressive. Natural hollows deepen quickly, and bony projections grow prominent.

In no disease with which I am acquainted does the temperature run a more erratic course. It may resemble the temperature of a quotidian type of intermittent fever, or closely simulate that of typhoid fever, or noticeable elevations may be entirely absent. To me the most interesting thermometric readings are those in which the temperature ranged from 96.5° to 103.6°. A considerable number of my own cases have exhibited repeated subnormal temperatures, so much so that I am obliged to regard an occasional subnormal temperature in the presence of other symptoms as quite suggestive of hepatic abscess. Can it be that the destruction of so much of the tissue of this great calorifying organ is responsible for this reduction in body heat? It is not so apparent in any other septic process.

My own observations on the behavior of the urine are insufficient for any well-marked conclusion. It is always scanty, of deep color, high specific gravity, and the majority of instances in which I have examined it, abundant deposits of urates were present.

In a fairly large percentage of cases the spleen has been distinctly enlarged.

The most constant, and, therefore, the most valuable symp-

toms I have observed in this malady, may be briefly summarized as follows:

1. A history in which dysentery and chill appear.
2. General malaise pronounced.
3. Pain and tenderness over liver.
4. Enlargement of liver.
5. Hectic, sweats and rigors.
6. Right-side posture.
7. Erratic temperature, running from 96.5° to 103.5°.
8. Progressive emaciation.
9. Gastric disturbances.

TREATMENT. This should be prompt, bold, and radical. No measure will succeed which does not completely evacuate the abscess cavity and allow free drainage. This can only be done with precision and safety by incision. Aspiration, puncture with trocar, direct puncture with scalpel, opening by caustics or thermocautery are uncertain, insufficient, dangerous, and unsurgical, and are mentioned only to be condemned. The route by which the liver is entered may be either transperitoneal or transpleural. Where the abscess can be attacked from the front, the operation of incision and drainage is comparatively simple. The transpleural method presents greater difficulties, and the gravity of the situation is increased. The line of incision will be determined by the position of the abscess. It may be made below the free border of the ribs by an oblique cut, or a vertical one if the abscess points forward or downward; or, by resection of a part of one or more ribs, the abscess may be attacked from the side or behind. If an oblique incision is practised in front it should be sufficiently removed from the border of the ribs to allow the wound in the liver to rise, as reduction in size takes place from subsidence of swelling, without passing up under the ribs to a point where it would be overlapped by the ribs, and thus interfere with drainage. On acccount of the actual occurrence of this accident, a vertical incision is preferable, especially in those cases where the tumor has descended far below the ribs, and thus allows an ample field for a liberal vertical cut.

In any case, the cut to reach the liver should be an abundant

one. Through a large opening we work with greater ease, celerity and safety, and easier access to the liver is obtained, and that part of the incision which is not needed for manipulation or drainage can be subsequently closed.

Upon reaching the liver, in a certain proportion of cases it will be discovered that adhesions have already formed sufficient to protect the general peritoneal cavity and allow the immediate opening of the abscess without further care or fear. This may be done by sending in an aspirator needle to locate the abscess cavity with accuracy, and, if the abscess is deep-seated, furnish a guide for the bistoury. If the wall is thin this is superfluous.

Where no adhesions have occurred, provision must be made to protect the peritoneal cavity against possible contamination, for while it is well understood that the pus of many hepatic abscesses is sterile, yet we cannot say in advance that the pus in any given case is sterile, and we should, therefore, take no risk, but seek to protect the peritoneum against any possible infection. This in such cases may be accomplished in one or two ways: either by doing the operation in two sittings, packing the wound and forcing adhesions, or else by providing against the possible entrance of pus into the peritoneal cavity at once, incising and draining the abscess and then stitching the margins of the hepatic wound to the deeper portions of the superficial wound. This must be done with the utmost care and security, and even when thus accomplished additional precaution should be taken in the arrangement of packing, by which the line of contact is further secured against leakage.

In passing through the pleura it will be found necessary to resect a portion of a rib, and sometime two ribs, in order that ample access to the liver may be afforded the operator. The opening into the pleura must be made cautiously, and the parietal layer of the pleura seized and held in the grasp of hæmostats, in order that there may be no fumbling to find the cut margins when they are needed to be sewn to the diaphragmatic incision, and also that the wound may not gap unduly, as it is desirable to admit as little air into the pleural cavity as possible. The diaphragmatic pleura should be incised to correspond to the

first opening, and the cut margins of the two incisions forthwith sewn together with a continuous suture of fine catgut. When the pleural cavity is thus shut off by this "button-hole" through it and the diaphragm opened, the remainder of the operation is identical with that from the front. The opening into the liver should be as free as safety will allow, in order that the cavity may be thoroughly cleansed and drained.

The next step is to evacuate the cavity and cleanse its walls. This may be accomplished by irrigating with warm boric or carbolic solutions, after which the cavity may be wiped out and dried with pledgets of cotton or gauze; or no fluid being thrown into the cavity, it may be merely mopped out. Drainage is now to be provided for. If the cavity is very large, this should be assured by the introduction of one or more large rubber drainage-tubes, and a light gauze packing as well. In small cavities merely packing with gauze will suffice. When the cavity is large, and much discharge is expected, a very voluminous outside dressing must be applied, and changed as often as it becomes soiled.

In most cases healing occurs rapidly, the discharge of pus daily diminishes, and the cavity contracts perceptibly. The patient's general condition promptly improves also. It occasionally happens, however, that the process of repair is tardy and unsatisfactory. This may in some cases be due to a cachexia, which will have to be overcome by judicious constitutional treatment, or to the state of the abscess walls, which may require stimulation to produce healthy granulation. Of all remedies suggested for this purpose, a weak solution of carbolic acid (2 per cent.) I think best. The general methods of hygiene must be applied in every case which, as a rule, will be properly responded to.

The accidents most likely to occur in opening a hepatic abscess are contamination of the peritoneal cavity by the premature rupture of the abscess in manipulation, or awkwardly opening it after exposure. Neither ought to occur, and will not, if gentleness and cautiousness prevail. Hemorrhage from the wounded liver may be severe, and is most likely to occur in

those cases where much liver tissue is traversed to reach the abscess. As a rule, such hemorrhage can be controlled by forci-pressure, packing, or the application of sutures with a curved needle, taking in sufficient quantity of liver tissue. On account of the brittle character of the liver substance, such sutures are never to be too tightly applied, for fear of cutting through.

The advantage of incision over other methods of treatment will be demonstrated by a comparison of the following cases:

Case I.—September, 1878. O. C., aged thirty-three years, blacksmith. Born in Ireland. Has resided eleven years in Richmond. Gives history of excellent previous health, having had no serious illness prior to one year ago, when he suffered a mild attack of malarial fever. Had been confined to his bed two weeks when I saw him in consultation. Present sickness began six weeks ago, with loss of appetite, increasing constipation, occasional nausea and vomiting, prominent thirst, coated tongue, flush face, "feverishness," some headache, and two nose bleedings. Pain and sense of heaviness in region of liver. Pain radiating to right shoulder and increased by every movement. Clothing seemed to exert disagreeable pressure. Rigors and sweats at irregular intervals. Had taken mecurials and large quantities of quinine with no abatement of symptoms. Patient prefers to lie on right side with thighs flexed. Turning to opposite side gives dragging pains over the liver. Skin sallow. Anxious expression of face, much emaciated. Voice weak and husky. Severe, dry cough. Tongue furred in the middle and at its base, but red at its tip and around margin.

Examination showed lower portion of abdomen somewhat retracted. A very distinct bulging of right hypochondriac region. Liver dulness increased in every direction. Great tenderness over liver. Obliteration of intercostal spaces from sixth down. Border of liver belt four inches below margin of ribs. The skin over the swollen area appeared glazed and tense. Respiration hurried, pulse quick and feeble, temperature erratic, ranging irregularly from 97° to 103°. Urine loaded with lithates.

Hepatic abscess diagnosed and aspiration advised. A medium-sized needle was chosen and introduced from the front. Eighteen ounces of fœtid, chocolate-colored pus withdrawn. Following this there was some cessation of pain and cough and sleeplessness and an apparent

general improvement for a few days. The cavity rapidly refilled, and sixteen days afterward was again evacuated by aspiration, this time drawing off twelve ounces of pus of a deeper color, but less fœtid. Following each withdrawal of pus profuse sweating occurred, and a subnormal temperature developed, 97°, lasting for twenty-four hours. Four days after the second aspiration diarrhœa set in, which could not be controlled, and death ensued. No autopsy.

Case II.—January, 1879. C., aged twenty-eight years, puddler in iron works. Born in Ireland. Seventeen years in Virginia. Has enjoyed exceptionally good health. In early autumn of 1878 had an attack of typhoid fever, during which there occurred intestinal hemorrhage. Ever since this illness has had "weak bowels," having frequent diarrhœa. For the past three months has been incapacitated for even light work. Present sickness began with digestive disturbances, poor appetite, eructations of food and much gas, colicky pain, occasionally nausea and vomiting. Lost flesh rapidly. Skin became dry and sallow, but never jaundiced. Deep inspirations were painful; could not lie on left side comfortably.

Expression anxious; tongue red and raw looking; very nervous and sleepless; complains of vague headache and dizziness; pulse rapid; temperature ranges from 99° to 103° F. Hectic with copious sweats and frequent rigors. Large swelling over region of liver. Tenderness exquisite; skin red and œdematous; liver dulness not increased upward but downward, to as much as five inches below costal border. Lungs healthy. Urine normal. Tumor fluctuated.

Hepatic abscess diagnosed. Aspiration practised. At least two pints creamy pus withdrawn. The operation caused great faintness accompanied by profuse sweating. Little, if any, amelioration of symptoms. Cavity quickly refilled. Death occurred fourth day after aspiration.

Autopsy, which involved only an examination of the abdominal viscera, showed the abscess to have been located in the right lobe of the liver. Adhesions to the anterior abdominal wall were extensive and firm. The abscess was burrowing toward a point two inches below the tip of the eleventh rib, this being the thinnest portion of the abscess wall. The wall was rough and irregular, and large fragments could be easily detached from it by sweeping the finger around it. The spleen was twice its normal size and much engorged. There were several cicatrices in the intestines where the typhoid ulcers had healed. Kidneys healthy.

Case III.—October, 1879. B., aged thirty-one years, farmer. Resided in Hanover County, nine miles from Richmond. Born in France. Twenty years in Virginia. Healthy as a youth; habits good. Had been ill six weeks when I saw him with what was thought to be malarial fever. Sickness began with a violent chill, followed by high fever. Pain and great tenderness over liver. Rigors frequent; fever in the beginning constant. Would not yield to large doses of quinine. Nausea prominent symptom from first; now and then vomiting of much bile. Tongue coated with white fur. Diarrhœa more or less severe throughout; stools yellow and thin. Loss of appetite complete, craves acid drinks. Some headache. Pain and tenderness over liver have been persistent. A gradual bulging below ribs in right hypochondrium was noticed. Rigors and night sweats and rapid emaciation. Skin the color of a frost-touched hickory leaf, except face, which is dusky. Slight icterus. Temperature at this visit 96.5° F. Doctor in attendance told me he had several times found it subnormal.

During the early days of sickness laid on back; now lies on right side with small pillow tucked under the short ribs. Liver dulness not increased upward. Liver border reaches nearly to umbilicus. Indistinct fluctuation.

Diagnosed hepatic abscess. Aspiration from the front was practised on following day and a large quantity of lumpy, chocolate-colored pus pumped away. Symptoms were somewhat improved for ten days. Diarrhœa was lessened, temperature fell to normal, and remained so for the greater portion of the time, although it would occasionally mount up to 100° and now and then go down to 97°. Pain and tenderness much diminished. On the eleventh day after aspiration patient was seized with a second violent chill, and all the unfavorable symptoms returned. I was called four days afterward and went prepared to again aspirate. Death had taken place two hours before my arrival.

An incomplete autopsy showed a very large abscess in right lobe of liver. Adhesions in front were imperfect. Abscess had ruptured into the perineal space, which was filled with the same character of pus withdrawn by aspirator. The abscess wall was mushy and very irregular and shreds of necrotic tissue suspended from it. The spleen and kidneys appeared healthy. The intestines were not opened.

Case IV.—August, 1880. R., aged forty-nine years, farmer. Lived all his life on the lower James River. Has had many attacks of chills and fever and three of well marked dysentery; otherwise has enjoyed

good health. The last attack of dysentery began in June of present year and lasted three weeks. Has never been entirely well since. Has not recovered flesh or strength, on the contrary has steadily emaciated. When sufficiently convalescent from the dysentery to move about the house, began to have pains and tenderness over the region of his liver. These increased, and he called his physician's attention to them. Loss of appetite, furred tongue, headache, rigors, and sweats grew more and more pronounced. A swelling occurred in the right side. For this he was brought to Richmond and put in my care.

I found the liver much enlarged upward, very painful and tender, tongue coated, bowels relaxed, occasionally discharging mucous tinged with blood, straining at stools now and then. Temperature varying at most irregular intervals from 97° to 102.5°. Pulse quick and weak. An exceedingly irritating cough, no expectoration. Intercostal spaces filled.

Hepatic abscess diagnosed. Aspiration practised in mid-axillary line through ninth intercostal space. Twelve ounces of curdy pus withdrawn. All unfavorable symptoms decreased and improvement satisfactory for three weeks. Swelling then began to reappear, accompanied by a return in aggravated form of former symptoms. He was again brought to Richmond and a second aspiration practised. No improvement after this aspiration. Exhaustion was rapid, and death followed in two weeks with apparent refilling of abscess cavity. No autopsy.

Case V.—In September, 1881, I saw a musician, aged twenty-six years. He had been confined to the house for eight weeks, and for the greater part of the last four weeks of this time was in bed. Acute phthisis was the diagnosis made by the physician who preceded me. Inquiry revealed the fact that he had enjoyed good health until the middle of June of this year. An attack of dysentery occurred then. This was severe and protracted. Never since this attack have his bowels been entirely regular.

In July had a severe chill, followed by intense pain in right hypochondrium. Continued fever. Great sensitiveness over liver extending up chest wall to near the nipple. A large swelling rapidly developed, with bulging of intercostal spaces. A most distressing cough came on, no expectoration. Hectic, sweats, and rigors. Could not lie on right side nor on back without the body was propped on several pillows. Respiration much accelerated and painful. Very

sleepless, pain in head, complete loss of appetite, some nausea and vomiting. Lost flesh rapidly.

Hepatic abscess diagnosed. Aspirated through ninth intercostal space. A quart of blood-stained pus withdrawn. Some abatement of septic symptoms. Cough somewhat lessened and nervousness diminished. Improvement lasted only a few days when cavity again refilled. Was again aspirated, and a third aspiration determined on and the day appointed. On the morning of that day a violent fit of coughing and smothering came on and a quantity of bloody pus was discharged from the mouth. His condition was perilous for an hour, suffocation being imminent. After this the flow of pus began to diminish and he was much relieved. As long as he sat up there was no flow of pus. As soon as he attempted to lie down, coughing came on and pus was expectorated freely. Rupture into bronchus was recognized. He was required to drain the abscess cavity by lying across a bed on his belly and hanging his trunk partly over the side of the bed. When such a position was assumed pus would flow freely from the mouth. If it came rapidly enough to strangle him, he would get immediate relief by sitting upright. This method of drainage was persevered in steadily, and improvement was rapid. There was daily diminution of the pus flow. Hectic disappeared, the hepatic swelling subsided, the digestive functions were restored, and at the end of three months the man was in robust health. I have seen him within a fortnight, and he tells me that he has had no sickness since his recovery from the hepatic abscess.

Case VI.—July, 1882. O., negro, aged thirty-three years, carpenter, Splendid health until May, 1882. Had then an attack of acute diarrhœa, for which he received no professional treatment. Diarrhœa subsided in two weeks. Soreness in abdomen did not disappear. Suffered much from digestive disturbances, loss of appetite, nausea, and vomiting. Pain and tenderness over liver. Swelling below margin of ribs on right side, extending half way to umbilicus. Some jaundice. For this swelling and pain I was called. Swelling was very visible. Tumor was smooth and firm. Could make out margin of liver. Rigors with very abundant sweats. Had emaciated rapidly. Temperature ranged between 99° and 103°. Pulse rapid and weak. Could not lie on left side as it occasioned great distress, as if "something was tearing." Tumor grew rapidly. In a week had extended to umbilicus.

Hepatic abscess diagnosed. Aspiration resorted to. Needle entered from the front. A quart of chocolate-colored pus obtained. Great

relief followed. Improvement continued for fifteen days, when swelling reappeared rapidly, with renewal of septic symptoms. Five aspirations were practised at intervals, varying from ten to fifteen days, with large quantities of pus removed at each aspiration, and each was followed by some amelioration of symptoms. When it was apparently time to aspirate the sixth time; on violently sneezing something was felt to "give way" in the abdomen, with almost complete subsidence of the swelling. Great shock ensued from which he could not be induced to react, and death followed within twenty-four hours. No autopsy.

Case VII.—December, 1882; C., aged forty-eight years, laborer in City Gas Works. Saw this patient in consultation. Had been gradually failing in health for six months. Health previously good. Symptoms chiefly referable to abdomen. Mild pain, not localized. Complete loss of appetite, alternating diarrhœa and constipation. Sometimes fever, night-sweats, and occasional rigors; tongue coated; breath fetid. Lungs and heart normal. Belly retracted. Mesenteric glands enlarged. No swelling or tenderness over liver. Death from exhaustion.

Autopsy showed mesenteric glands generally enlarged; kidneys healthy; spleen slightly oversize; liver natural in outward appearances. Incision into right lobe opened into an abscess cavity as large as an orange, containing thick, greenish, curdy pus. The walls were dense and quite smooth. Hepatic abscess had not been suspected.

Case VIII.—July, 1883; W. aged sixty years, laborer. Very frail, delicate person. Health had never been good. All his life had suffered with dyspepsia. Had resided fifteen years in Arkansas. While there suffered severely from chills and dysentery, of which he had an attack every summer. Lived in Richmond since October, 1881. Was able to work until June 1, 1883, when a severe attack of dysentery came on, lasting three weeks. Before he recovered strength after his attack, began to have tenderness and pain over the liver, with perceptible swelling downward; wasting was rapid; exhaustion profound, accompanied by fever, sweats, and rigors. Swelling grew rapidly, extending to within one inch of the umbilicus, and pain and tenderness increased. Skin over the swollen area became red and œdematous; tongue fiery red and sore; complete anorexia; constant diarrhœa; temperature was many times subnormal to the extent of a degree and a half; pulse rapid, feeble, and thready. Could only lie

on right side; when turned to left, felt a drawing, dragging sensation in right side.

Hepatic abscess diagnosed and aspiration practised. Puncture made an inch below tip of ninth rib. Seventeen ounces of pus much tinged with blood withdrawn. Death occurred in four days. No autopsy.

Case IX.—September, 1883. Mrs. W., white woman, aged forty-seven years, housewife. Previous good health, never any serious sickness. Had chills and fever during summer of present year. General health failed; lost flesh and strength; became sallow and slightly jaundiced; suffered much from nervousness; slept badly; had repeated "cold spells," but did not shiver. First noticed that rising from a chair or going downstairs "jolted" her right side under the short ribs. Lying on left side "pulled" her in some places; could only lie comfortably on right side or on back with shoulders elevated. A dry, irritating cough soon developed. Could not "get under the phlegm to raise it." Had night sweats. Outbreaks of diarrhœa lasting about three days spontaneously controlled; temperature varied from 100° to 103.5°; right hypochondrium greatly swollen. Liver dulness extended from fifth intercostal space to three inches below border of ribs; intercostal space obliterated; respiration rapid and difficult; voice much altered; pulse quick and feeble; hectic very pronounced. Could not discover fluctuation below ribs.

Hepatic abscess diagnosed. Aspiration practised. Puncture made in axillary line through ninth intercostal space. Two pints of blood-stained pus extracted. Cavity refilled rapidly and was again punctured, this time with trocar and canula just below free border of ribs, and rubber drainage-tube inserted and left in. Discharge of pus profuse. Symptoms much relieved for three weeks, after which case remained stationary for a time. Discharge through tube continued, notwithstanding apparent sufficient drainage. Septic symptoms became aggravated and death ensued from exhaustion one hundred days after first tapping.

Case X.—November, 1883. A., negro, aged apparently thirty years, farm hand, working on the banks of the Chickahominy River since May of present year. Returned to his home in Richmond because he had been disabled by sickness. Very ignorant, could give no intelligent account of his sickness, only stating that he had had several "spells of bloody flux and ague." I found him much emaciated and weak. Conjunctiva icterosed, tongue red, no appetite,

bowels constipated, liver swollen and tender, skin over swelling œdematous. Fluctuation could be made out over the swelling, which extended nearly to the umbilicus. An aspirator needle was introduced at most prominent point of swelling and entered at once into large abscess cavity. Twenty ounces of creamy pus withdrawn, which became streaked with blood as the last few ounces came away. The withdrawal of the pus was followed by a subnormal temperature which lasted forty-eight hours. No improvement of symptoms, and death followed eight days after aspiration. No autopsy.

Case XI.—Miss A., aged thirteen years. Saw this patient with the late Dr. R. T. Ellis. She had suffered an attack of dysentery in June. In August, when she was yet incompletely recovered, was seized with a violent chill, followed by high fever. Very soon pain and tenderness over the liver came on. Tongue coated with thick, white fur, bowels relaxed, some vomiting, frequent nose bleedings, respiration embarrased from time of chill. Could not lie comfortably on left side, emaciation very prominent, skin sallow, liver enlarged rapidly, chiefly in upward direction. Dry, irritating, exceedingly distressing cough, no expectoration. Frequent shiverings, profuse sweating, temperature often subnormal reaching 103° F. when highest.

Hepatic abscess suspected. Puncture with aspirator needle in the ninth intercostal space withdrew seven ounces of greenish-yellow pus. Some abatement of symptoms. Cavity soon refilled. Death on twenty-seventh day after chill. No autopsy.

Case XII.—September, 1890. R., little girl aged six years. While running in the street, tripped, and fell violently against the curbstone, striking her right side. Got up and walked home. Felt sick and painful and vomited some. A physician was called and pronounced the injury not serious. A large ecchymosis appeared, little superficial swelling. Soreness continued. Child would not leave its bed. On fourth day had a chill. Deep pain and soreness under area of bruise came on. Symptoms became tumultuous, face greatly flushed, conjunctivæ injected, pulse rapid, breathing hurried and painful, tongue red, diarrhœa, headache, and great restlessness. A pronounced swelling appeared, bulging from beneath the border of the right ribs, which in seven days reached to the umbilicus. Sweats and rigors occurred. Temperature from 100° to 104° F.

Traumatic hepatic abscess was diagnosed and incision recommended. The family declined any operative interference. On the fifteenth day after the injury child was seized with a violent tearing pain in the

side, followed by sudden and prolonged collapse. Pain lasted an hour and swelling materially diminished. In twelve hours well marked septic peritonitis developed, and death occurred in four days. No autopsy.

Case XIII.—August, 1893. (Dr. W. B. Towles, University of Va.) Young merchant, aged thirty-three years, married, father of seven children. He had had five attacks of dysentery, and in the intervals between these attacks he enjoyed fair health. In March last he began to complain, and after two or three days he was confined to his bed with an attack of dysentery, which was his last attack, and lasted until April 28th. Recovering from that attack sufficiently to be about and attend to his business, he began to manifest symptoms in the region of the liver, which caused his physician to suspect that he had abscess of the liver. The patient's health improved under Dr. Towles' care for a time, but soon began again to decline. The gentleman saw Dr. McGuire, who ordered him to go to a sulphur spring. He went to a sulphur spring in Virginia, and in a short time afterward Dr. Tiffany diagnosed abscess of the liver and advised an immediate operation. He came home (Charlottesville); I was telegraphed for and concurred in the diagnosis Tiffany had made, and advised operation. He was brought to Richmond two days afterward and placed in the Retreat for the Sick.

An aspirating-needle was used for the purpose of locating the abscess cavity. The puncture was made through the tenth intercostal space, and after passing the needle in three directions I finally succeeded in tapping the abscess-cavity and withdrawing pus. The general direction of the needle was borne in mind, and the patient prepared for a surgical operation. The anterior two-thirds of the ninth rib were excised, the pleural cavity cut into, and the diaphragmatic pleura was incised in such a fashion as to make the incision correspond with the cut in the parietal layer; the margins were stitched together, the diaphragm incised, and we came at once down upon the liver. By palpation a bulging was detected in the part of the liver where the abscess existed. As far beyond the infected region as possible deep sutures of strong silk were passed with curved needles into the substance of the liver at each extremity of the wound, and the liver drawn up snugly into the wound. The surrounding parts were packed in such a manner as to prevent the escape of pus into the peritoneal cavity, the pleural cavity having been thoroughly cut off by the stitching of the two layers of the pleura, and the abscess was incised. An enormous quantity of pus escaped, and when the cavity was

thoroughly evacuated and swabbed out the margins of the wound in the liver were stitched to the margins of the wound in the diaphragm, so that the wound in the liver corresponded to the wound in the chest-wall. A large drainage-tube was inserted and a voluminous dressing of gauze and cotton applied, which was renewed as it became soiled. At first the discharge was free, but gradually diminished, and the urgent symptoms soon began to subside. The temperature, which in the morning was 103°, in four hours after operation subsided to 96°, and remained subnormal for four days, after which it became normal, and never passed beyond 99° F. during the remainder of convalescence. The cavity was flushed from time to time with a weak solution of carbolic acid. A nutritious diet was prescribed, and occasionally minute doses of deodorized tincture of opium administered sufficient to relieve the trifling pain he suffered. In a week from the day of the operation it was manifest that the patient was taking on flesh and improving. The operation was performed on August 27th, and on September 21st the patient was discharged from the hospital with a tiny drainage-tube in the wound, which had been shortened from time to time until it represented nothing more than the depth of the tissues intervening between the surface of the liver and the exterior of the body. The remaining portion of the wound had thoroughly granulated and had cicatrized. This drainage-tube was finally removed at the end of the fifth week. At the end of the sixth week the patient had gained fifteen pounds in flesh, and was again attending to his business, absolutely cured. No amœbæ found.

Case XIV.—December, 1893. K., aged fifty-five years, carpenter. Good health until three months ago; never had a serious sickness. Grew sick gradually, general indisposition, loss of appetite, bad taste in the mouth, furred tongue, constipation. No pronounced symptoms until December 4th, when high fever came on, accompanied by delirium. Chills, with profuse sweats followed. Consulted Dr. Blanton December 6th. Temperature then 103°, abdomen distended, bowels steadily constipated, swelling and great tenderness over left hypochondriac region. Purgation with mercurials and counter-irritation relieved pain and reduced temperature to normal. Remained so twelve hours. Again rose to 103°. Swelling increased rapidly, tenderness and pain became unbearable. Required morphia. Some nausea, great muscular weakness. Saw patient December 11th. Abscess of left lobe of the liver diagnosed. Removed to the Old Dominion Hospital and operated on next day.

The tumor bulged from beneath the ribs and extended to umbilicus. Skin over tumor red and œdematous. Incision over most prominent part of tumor. It was found on opening the peritoneum that adhesions had formed. An aspirator-needle was introduced into abscess-cavity, the wall of which was thin. Pus flowed through the needle, a bistoury was inserted alongside of the needle, and an ample opening made. It was estimated that at least a quart of thick, creamy pus escaped. The cavity was carefully and gently mopped with gauze pledgets until it was clean, and then irrigated with a 2 per cent. solution of carbolic acid. A large rubber drain was introduced, and a light iodoform gauze packing placed in as well. Voluminous outside dressing applied.

Temperature fell immediately after the operation to 97°, and remained so forty-eight hours, when it gradually crept up to normal, from which it never varied during remainder of convalescence. There was practically no discharge from the abscess-cavity afterward, and only infrequent dressings were required. The cavity closed with wonderful rapidity, and the patient's general condition steadily improved, and at the end of four weeks closure and cicatrization were complete. He recovered flesh promptly, having an excellent appetite throughout after the second day from the operation. The pus in this case was examined for amœbæ, and none were found. He had never had malaria or dysentery.

Case XV.—February, 1894. (Dr. R. T. Ellis.) A., aged sixty-three years. Previous to one year ago enjoyed good health. For past year has never been well. In the spring and summer of 1893 had several attacks of dysentery, became emaciated and feeble. In October, 1893, had a severe sickness of four weeks' duration. Diagnosis, continued fever. February 1, 1894, took to bed after a severe chill. Temperature rose to 104°, and remained above 102° four days. Then began to fluctuate between 96.5° and 102.5°, remaining at 97° for as much as twenty-four hours at a time. Severe pains in right side under short ribs. Much tenderness on pressure. Insomnia, headache, fleeting delirium. Bowels disordered, first constipated and then diarrhœa, some nausea and vomiting. Tongue red and denuded, and breath fetid. Great thirst, skin sallow and harsh. Expression anxious. Urine loaded with urates.

Saw this case in consultation February 23d. Liver greatly enlarged downward, no upward increase. Could lie only on right side, with pad or small pillows under side. All movements provoked pain. Intense tenderness on pressure.

Diagnosed hepatic abscess of right lobe. Sent to Old Dominion Hospital same day. Operated on February 24th. Incision oblique, parallel to border of ribs. Peritoneum opened showed no adhesions. Packed wound about with iodoform gauze to cut off peritoneal cavity. Incised peritoneum of liver to correspond with external wound, and stripped it back for a half-inch. Guided by the needle of a hypodermic syringe, introduced bistoury into abscess-cavity and evacuated its contents, which amounted to a pint and a half of chocolate-colored pus, having a very fetid odor. When this was done the walls were examined both by touch and inspection. They were found to be rough and irregular, and from them trabeculæ hung in festoons. The walls were washed with a 2 per cent. solution of carbolic acid, two large rubber drains and some iodoform packing placed, and an outside dressing put on.

The patient reacted promptly, except that his temperature remained subnormal for eight days, ranging from 96.8° to 97.5°. In every other respect he did exceptionally well, making a complete recovery, and was discharged from the hospital March 17th, with the cavity sufficiently closed to require no more packing than would fill an ounce measure. At the end of six weeks cicatrization was complete. The pus in this case was examined and found to contain large numbers of active amœbæ.

Case XVI.—Mr. D., Ashland, Va., 1894. I was called to see Mr. D. in consultation with Drs. Scott and Jones. He had been ill for six weeks with an obscure affection. His health had failed gradually, with emaciation, and he was now very feeble. Previous to this sickness his health had been good. The most notable early features of this attack were successive crops of boils which did not slough through the skin. These appeared over his trunk and limbs and were very painful. He suffered distinct pyæmic symptoms. Emaciation came on early and was marked. Rigors, distinct chills, and drenching sweats; sallow skin, icterosed conjunctivæ. Pulse rapid and feeble. Three weeks ago began to complain of vague pain in the region of the liver, which radiated to right shoulder. A cough, which grew steadily worse, appeared; no expectoration. Breathing interfered with, could not lie flat in bed, had to have shoulders raised and tilted so as to lie partly on right side. Temperature ranged from 99° to 103°. Tongue greatly coated. Prominent diarrhœa.

Examination showed liver much enlarged, extending to fourth intercostal space and two inches below rib margins. The side bulged per-

ceptibly, and the intercostal spaces were obliterated. Fluctuation distinct.

Hepatic abscess was diagnosed and immediate operation suggested. Recommendation declined. I stated to his physician my belief that the abscess would soon rupture through the bronchi and suddenly terminate his life. The prediction was verified, for on the third day after the consultation, in a hard fit of coughing, pus gushed from his mouth and nose, he became violently strangled and expired in a few minutes, drowned in his own pus. No autopsy.

CASE XVII.—February, 1897. (Dr. W. A. Lee.) C. R., negro, aged forty-five years, porter. During the war was thought to have consumption, but went to the country and got well. About twelve years ago had epididymitis, and later gonorrhœa. About eight years ago had pneumonia, and fifteen years ago had pleurisy. Has had piles off and on for eight or nine years. Some years ago would not be bothered at all. Bowels usually constipated, but would sometimes have diarrhœa, with passage of some blood, but this only lasted about a day, and would yield to treatment. Had a spell of diarrhœa just before this illness, but at this time had not had piles for about three months. For a year previous to this attack had suffered occasional pains in the abdomen, usually in lower part, which he ascribed to colic, and would take Squibb's mixture with relief, but pains would come back. Was taken violently sick on January 7, 1897, but pain had moved up to pit of stomach. Pains were of an intense, severe cutting character. About a week later, midway between ensiform cartilage and umbilicus a lump appeared. Was given morphine and blistered, but without relief. Lump continued to grow, and was exceedingly tender and hard, quite immovable, and apparently in abdominal wall.

Was operated on February 6th, and trouble found to be abscess of liver. Left lobe of liver firmly adherent to wall of abdomen. Cavity as large as hen's egg. Pus curdy and brown. Cavity drained by tube and gauze. Complete recovery.

CASE XVIII.—April, 1897. C. I. R., male, white, aged twenty-eight years, carpenter. Had always been healthy. Had typhoid fever ten years ago, no other sickness sufficiently severe to confine him to bed. For the past two years had had attacks of cramps in abdomen, which he regarded as colic. At times these would come on very suddenly and were very severe, but did not last long. Had such an attack first day of April. A physician administered morphine hypodermically, which relieved pain, but tenderness in middle epigastric region con-

tinued. The family physician diagnosed case as one of gallstone, for which he was treated three weeks. I saw him first on April 20th. From his own account he had had continued fever, sweats and rigors, much nausea, and sometimes vomiting. Diarrhœa and constipation had alternated. He had lost fresh rapidly, and was now greatly emaciated.

A very conspicuous tumor extended entirely across the upper zone of the abdomen and two inches below the umbilicus. Its most prominent part was in the middle line, midway between the ensiform cartilage and the umbilicus. It was smooth, very tender, and fluctuated.

Skin sallow, conjunctivæ slightly icterosed, tongue red and glazed. Pulse feeble and rapid. Voice very weak. Temperature 100.2° F.

Hepatic abscess diagnosed and immediate operation advised. The following day was taken to the Old Dominion Hospital and operated on at midday. Incision was made in middle line. When the peritoneum was opened the diagnosis was verified. No adhesions. Liver bulged into the wound. The abscess-wall seemed so thin and the quantity of matter so great that I apprehended danger of infecting the peritoneal cavity if immediate opening was practised. After drawing a hypodermic syringeful of pus from the abscess, the wound was packed, I having determined to do the operation in two sittings. Chloroform was the anæsthetic. Reaction fairly good. During the five days I was waiting for adhesions he lost ground. When admitted his temperature was 99° F. On following day it dropped to 95.6° F. From 8 A.M. on 22d to 2 P.M. on 24th it remained subnormal. The evening temperature never rose but once above normal. This was at 8 P.M. on 25th. On the morning of the 26th the abscess was opened by a free incision. At least two quarts of chocolate-colored pus escaped. Large masses of necrotic tissue floated out with the pus, and others that were observed to be loose in the cavity were extracted with forceps. The cavity was a mammoth one; there seemed to be nothing left of the liver but its capsule. Cavity irrigated with warm boric acid solution, and very large rubber drain placed in, and cavity packed lightly with iodoform gauze. Voluminous outside dressing. These manipulations were very well borne, but in three hours he began to sink, the pulse weakened and grew rapid (120), frequent vomiting, first of greenish fluid and later a brown fluid Death took place about ten hours after abscess was opened. No autopsy.

My colleague, Dr. E. C. Levy, Demonstrator of Bacteriology in the

Medical College of Virginia, kindly furnished me with the following report on the pus withdrawn at the time the liver was exposed in the first operation:

"*April 21st.* The pus was obtained by direct puncture of the exposed abscess, by means of a steam-sterilized hypodermic syringe, and was immediately transferred to a sterilized test tube.

"Microscopical examination, made at once in hanging-drop preparation on warm stage, failed to show amœba coli. Cover glass preparations, stained with fuchsin, showed presence of a few short bacilli. A series of gelatine plates and an agar culture were made.

"*22d.* The agar tube, after twenty hours in thermostat, showed abundant white growth on surface, slight growth along stab. This growth was found to consist of short, slowly motile bacilli, with rounded ends. From this tube cultures were started and a second series of plates made.

"*24th.* Original set of gelatine plates showed, at the end of three days, flat, dry, irregularly notched, bluish-white, non-liquefying colonies. Under low power the color of these colonies appeared light-brown, with thicker centre. The sterility of the syringe used for aspiration was proved by the fact that all the colonies were of one kind. From one of these colonies, on plate No. 2, a second set of tubes was made.

"*26th.* Growth on all media, in both sets of tubes, profuse. Potato growth brown in color, bouillon cloudy with slight mycoderma, milk coagulated. Fermentation test in glucose bouillon showed abundant evolution of gas. Culture in peptone solution responded slightly to indol test.

"*Diagnosis.* Bacillus coli communis."

Conclusion. It will be observed that fifteen of my cases occurred in adult males, twelve in white subjects and three in negroes. Three occurred in females, all white, one adult and two children.

Eight gave histories of dysentery, one of diarrhœa, and one of recent typhoid fever.

In eight no previous attack of dysentery could be traced. One only gave history of trauma.

The results of treatment were as follows: in the first eleven cases, occurring previous to 1884, which were treated by aspira-

tion, ten died, one recovered. The recovery in this case was brought about by a spontaneous discharge through the bronchi. In the second group of seven cases, the first of which was seen in 1893, two declined operation. Both died. Five were treated by incision and drainage. Four recovered, one died.

The disastrous failures of treatment in my first eleven cases fill me with regret that the surgery of that day (1878–1884) was inadequate to cope with this malady, which, though always grave, is now so amenable to surgical intervention.

Agnew's *Surgery*, 1878, devotes three-fifths of a page (vol i. 362) to the subject of "Abscess of the Liver." Two and a half lines are given to prognosis. "The prognosis in hepatic abscess is unfavorable, a very large proportion of patients perish from exhaustion consequent upon the constitutional irritation which follows the liberation of pus."

"*Treatment.* Hepatic abscesses should not be prematurely opened. It is important that the work of inflammatory consolidation between the gland and the walls of the abdomen be thoroughly accomplished, and until this is effected there is little to be done, except to sustain the patient's strength by proper nourishment and the administration of tonics, such as quinine and aromatic sulphuric acid. When pointing takes place, accompanied by fluctuation, and the skin over the swelling assumes a purple discoloration, the abscess should be opened by making a puncture with the ordinary sharp-pointed bistoury. The pus which comes away is usually mingled with the biliary secretion. Many patients after the opening is made rapidly lose strength, and die in two or three weeks."

Harley, *Diseases of the Liver*, 1883, devotes six pages to treatment, of which this is the opening paragraph:

"The treatment of a hepatic abscess, whether it be of the idiopathic, traumatic, metastatic, or pyæmic varieties, in so far as the local suppuration is concerned is always the same. But the constitutional treatment varies according to the cause of the suppuration, Unfortunately, we can at best do but little more than alleviate the sufferings of the patient, for when once a collection of matter has formed in the liver the pathological

conditions upon which it depends are, as a general rule, beyond the physician's control. However, notwithstanding that a cure, or even a recovery, may in the majority of cases be unattainable, we must in no case fold our hands in complacent idleness, but be 'up and doing,' for even in the very worst of cases, as long as the thread of life remains unbroken there is always hope, and we have it within our power not only to soothe the patient's passage to the tomb, but very considerably delay the fatal issue."

He later recommends the use of the exploring-needle. He says: "In no case would I recommend the adoption of the proposal of Begin and Recamier, to attempt opening a hepatic abscess with a scalpel; nor do I advise the use of a large trocar, not even when the abscess has pointed, for the same advantage may be gained with a small trocar (just of sufficient diameter to allow pus flocculi to escape), and that too with less danger and inconvenience."

These two authors must be taken as types of the teaching of that day. Viewing the subject from our present advanced standpoint, it is not remarkable that he who received his inspirations from these sources should have death to follow in his wake.

A NEW APPARATUS FOR THE FIXATION OF BONES AFTER RESECTION AND IN FRACTURES WITH A TENDENCY TO DISPLACEMENT:

With Report of Cases.

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An extended discussion of the various methods of fixation of fragments after resection, or of fractures with a tendency to displacement, would be superfluous in this Association after the exhaustive paper presented to it four years ago. However, the fact that professional opinion has not yet given its sanction to any particular method is sufficient evidence that none has been perfected. Whether, as has been suggested, modern antiseptic and aseptic procedures, through the lack of reaction following them, are responsible for an increase in the number of cases of pseudarthrosis need not be discussed. It is certain that all see many of these unfortunate conditions. We believe that the time has come when a more accurate fixation of the bones, both after resection for cases of pseudarthrosis and for mal-union, and also for fractures with a tendency to displacement, particularly if they be compound, should be used.

I beg leave to call your attention to a new method of immobilization of the bones in these cases. I was led to devise it three years ago for a case the history of which will be given below. A young man had pseudarthrosis of eleven months' standing. While drawing a loaded shot-gun from the end of a wagon it was discharged, and he received the entire load in his arm above the deltoid insertion. The destruction of tissue was

so great that but a quarter of an inch of the shaft remained attached to the head of the bone. I knew of no method in use which would fix this upper fragment, controlled as it was by the rotator muscles. This instrument proved entirely satisfactory. It is a steel clamp made of separable pieces in order to secure easy and accurate adjustment. It is heavily plated with silver in order to secure the antiseptic action of that metal. Clamps of different sizes are made to correspond with the bone upon which they are to be used. The largest size is for the femur; the intermediate size for the humerus and tibia; the smallest size for the radius, ulna, fibula, and clavicle. The instrument consists essentially of four screws or shafts. On these are cut threads at the lower end and also near the upper end. The extreme upper end, however, is made square so that the screw may be governed by a clock key. Two sets of wing plates are attached to these screws, a shorter pair corresponding to the inner screws and a longer pair to the outer. Each is attached to its screws by two nuts, one above the plate and the other below, for accuracy of adjustment. When in position one wing plate overlies the other in each half of the instrument. When ready to be clamped these plates lie side by side. They are fastened together by a steel clamp with a screw at either end.

In my first instrument the wing plates were permanently fastened to the shafts, but at the suggestion of Dr. Hugo Mager, of Denver, I was led to attach them by these nuts in order to secure a more accurate adjustment. The nuts are controlled by a small wrench.

Any method of resection of the bony fragments which may be found desirable in the particular case may be used. The transverse is probably the most easy of execution, and generally the most desirable. The periosteum may or may not be separated from the fragments. Each fragment is drilled transversely to the longitudinal axis of the bone in two places. A small steel pin is thrust into the first hole while the second is being drilled, in order that they may be made parallel. The distance that these pins should be from each other and from the ends of

the bones should be determined by the bone under operation and by the size of the clamp to be used. The long shafts or screws are driven into these holes by means of the clock key and the wing plates adjusted. While the bones are held in accurate apposition the two halves of the instrument are clamped together. It will be found to absolutely prevent either lateral or longitudinal movement between the fragments. The instrument is long enough to permit the screws to project through the incision in the soft tissues so as to allow for the accurate suturing of the wound between its shafts, and also for the interposition of a dressing. The clamp should be removed at the end of from four to six weeks, depending upon the size of the bone operated upon.

I have also made a special form of clamp which I believe will be found useful in fractures of the neck of the femur. It has not been tried, however. It would seem to fix the head of the bone more securely than either the single screw or nail.

The following is an abstract of the histories of the cases upon which this instrument has been used.

Case I.—Operator, Parkhill. W. S., aged nineteen years, was sent from Walsenburg to St. Luke's Hospital, Denver, November 20, 1894. Pseudarthrosis of the right humerus as the result of a gunshot-fracture eleven months previous. An open infected wound communicated with the upper fragment. On November 22d this wound was scraped out, removing all the infected tissue. It healed kindly, and on January 3, 1895, the clamp was used for uniting the fragments. The bones were found separated a distance of two inches. The upper fragment had a length of one and a half inches including the head, and was very soft. Transverse resection. The wound was closed about the clamp without drainage. The extremity, including the chest, was inclosed in a plaster-of-Paris dressing. No reaction. The dressing was removed February 7, 1895, when the wound was entirely healed. No infection. The clamp screws were lifted out without force. The sutures were removed. A dressing and cast applied. This was removed at the end of four weeks. Perfect union was observed.

Case II.—Operator, Parkhill. M. M., aged forty years, was sent from Victor, Colo. Pseudarthrosis of nine months' standing, at the

junction of the lower and middle thirds of the right femur. There was great deformity with retro-displacement of the lower fragment, customary in such fractures. Operated July 7, 1896. An anterior section of the soft tissues showed the lower end of the upper fragment resting upon the anterior surface of the lower. No attempt at osseous union. A large amount of fibrous tissue was removed with the scissors. The oblique ends of the fragments were freshened by means of the rongeur and Volkmann spoon. A large size femur clasp was applied. Wound sutured about clamp without drainage. Sterilized dressing applied, and extremity inclosed in plaster-of-Paris. No reaction from operation. Dressing removed at the end of eight weeks. Perfect union of fragments. No infection of the wound. Small dressing applied and plaster-of-Paris splint for three weeks longer. Present condition, perfectly useful extremity.

Case III.—Operator, Parkhill. Delayed union. Dr. S. J., aged twenty-six years, on July 1, 1896, suffered oblique fracture of both bones of the leg at the junction of the lower with the middle third in a runaway accident. Temporary dressing in a fracture box. Later, when the swelling had subsided, in plaster-of-Paris. At the end of six weeks some evidence of union, but far from perfect. Very impatient to secure union and get about his work. Operated August 15th. Considerable amount of new osseous tissue filling the gap between the fragments. Also some fibrous tissue. Latter removed with a Volkmann spoon. Fragments drawn into accurate apposition and secured by a clamp. Wound sutured about clamp without drainage. Antiseptic dressing. Leg enclosed in plaster-of-Paris. No reaction. Clamp removed at the end of five weeks. No infection. Perfect union. Antiseptic dressing applied. Was given crutches. Perfect result at this time.

Case IV.—Operator, Parkhill. A. S., aged twenty-three years, pseudarthrosis of both bones of the right forearm as the result of a gunshot-injury received in Utah eight months previous. Sent to operator from Aspen, Col. Admitted to St. Luke's Hospital, August 12, 1896. Operated August 14th. Fracture in middle of the forearm. Fragments separated about one inch. Large amount of fibrous tissue between the bones. Transverse resection of all the fragments so as to secure a symmetrical forearm. A small clamp used for each bone. Wound sutured about clamps without drainage. Antiseptic dressing applied. The forearm enclosed in plaster-of-Paris splint. No reaction. Dressing removed at the end of six weeks. Clamps taken out.

No infection. Good union of both bones. Small antiseptic dressing applied. Forearm placed in anterior metallic splint. When seen two months later had regained considerable amount of motion in the fingers, and the hand promised to be a very useful one.

Case V.—Operator, Mager. Recent fracture with tendency to displacement. A. D., aged thirty-two years, travelling salesman. Steady drinker for some years. On December 24, 1895, while driving in the mountains, the horses became frightened and ran away. He was thrown from the buggy. Right leg caught in wheel causing compound comminuted fracture of both bones in the middle third. Admitted to the hospital the same evening. Wound cleansed mechanically and antiseptically. Small fragments of bone removed. Resection of fragments of tibia. Union by silver wire. Aside from normal aseptic fever, no reaction. At the end of a week, during sleep, a violent muscular contraction broke the wire and again fractured the lower end of the upper fragment. On January 5th second operation was performed. Second resection of upper fragment. Parkhill clamp used. Antiseptic dressing. Plaster-of-Paris cast. At the end of seven weeks dressings were removed. Union, but not strong. Antiseptic dressing reapplied. Perfect union at the end of ten weeks. Useful extremity.

Case VI.—Operator, McNaught. Pseudarthrosis of the right humerus. G. B., aged thirty-five years. Railroad accident November 2, 1895. Car wheel passed over the upper fourth of the right humerus, producing compound comminuted fracture. Great destruction of the soft tissue and bone. Lack of union after the wound had healed. Operated February 2, 1897, at St. Luke's Hospital. Transverse section. Parkhill clamp used, wound closed about the clamp without drainage. Antiseptic dressing. Plaster-of-Paris cast. Clamp removed at the end of six weeks. Good union, with useful extremity.

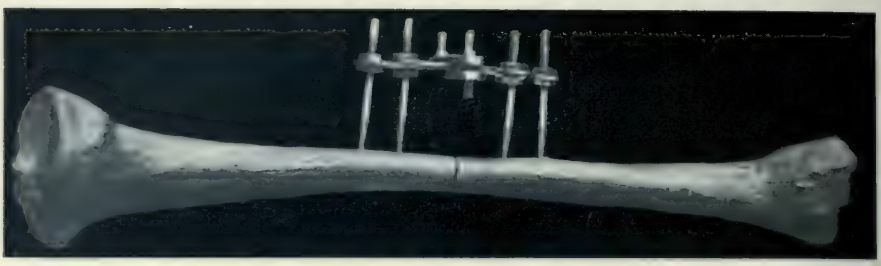
Case VII.—Operator, McNaught. Pseudarthrosis of the left humerus, one and a half inches from elbow-joint. H. H., aged sixty years. Operated May 21, 1896. Parkhill clamp used. At the end of six weeks the clamp was removed. Good union. Discharged from hospital. The night following discharge the patient, in a drunken spree, refractured the arm. The following November again presented himself for treatment, requesting that the same instrument be used. Clamp applied, and at the end of six weeks perfect union was obtained.

Case VIII.—Operator, Freeman. Pseudarthrosis of left humerus. A. C., aged thirty-five years. Eighteen months previous to operation

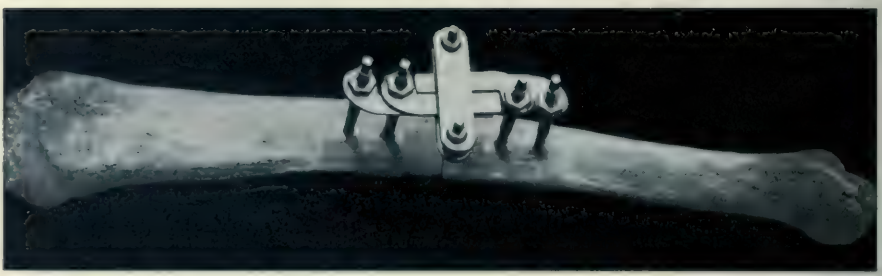
received comminuted fracture of the left humerus at the junction of upper and middle thirds. In May, 1896, admitted to Arapahoe County Hospital, Denver. Fibrous union and a small sinus. Operated by surgeon on duty. Resection of ends and suture by silver wire. Failure. Operated September 30, 1896. Ends again resected and united by Parkhill clamp. Upper fragment of shaft not more than one-quarter of an inch in length. Practically nothing but head of bone remaining. Clamp applied, size for femur instead of humerus, so that application was difficult. Much oozing from the wound. Impossible to entirely check it. This necessitated frequent changes of dressing for considerable length of time. Infection lasting about three weeks. Clamp removed November 3d. Perfect union at shoulder-joint. Patient could place hand on top of the head. Useful extremity.

Case IX.—Operator, Parkhill. W. M., aged thirteen years, malunion of the left femur of about ten months' standing, fracture having occurred at junction of upper with middle third. Upper fragment tilted upward and outward. Lower fragment united with it at an angle, producing great deformity and much shortening. Operated February 5, 1897. Anterior incision. Fragments separated with difficulty by means of saw and chisel. Transverse section of ends. Extremity extended, and a gain in length secured amounting to from an inch to an inch and a half. Clamp applied. Wound sutured about instrument without drainage. Antiseptic dressing and entire extremity and pelvis enclosed in plaster cast. Dressing removed at end of seven weeks. Perfect union and perfect symmetry of bone. No infection. A light dressing, with external and posterior light splint. Dressing taken off at end of nine weeks and splints removed. Was given crutches and is now walking on the extremity.

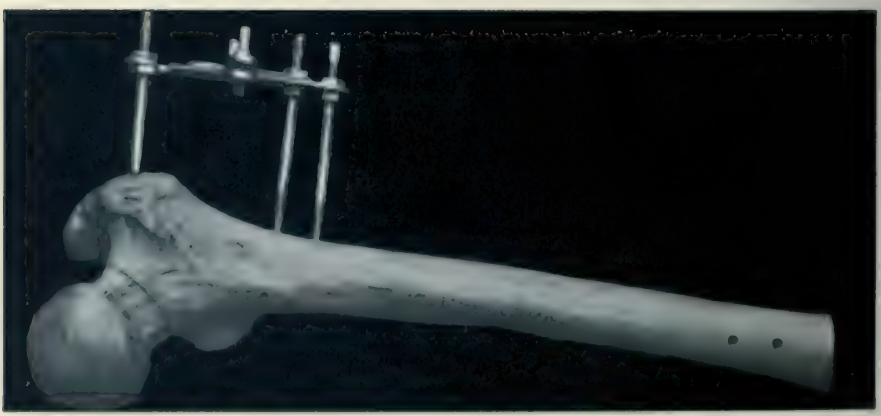
We claim for this instrument: first, that it may be easily and accurately adjusted, and prevents both longitudinal and lateral movements between the fragments; second, that nothing is left in the tissues which might reduce their vitality and lead to pain and infection; third, that no secondary operation is necessitated; fourth, that no method has ever before given 100 per cent. of cures.



Side view of clamp in tibia.

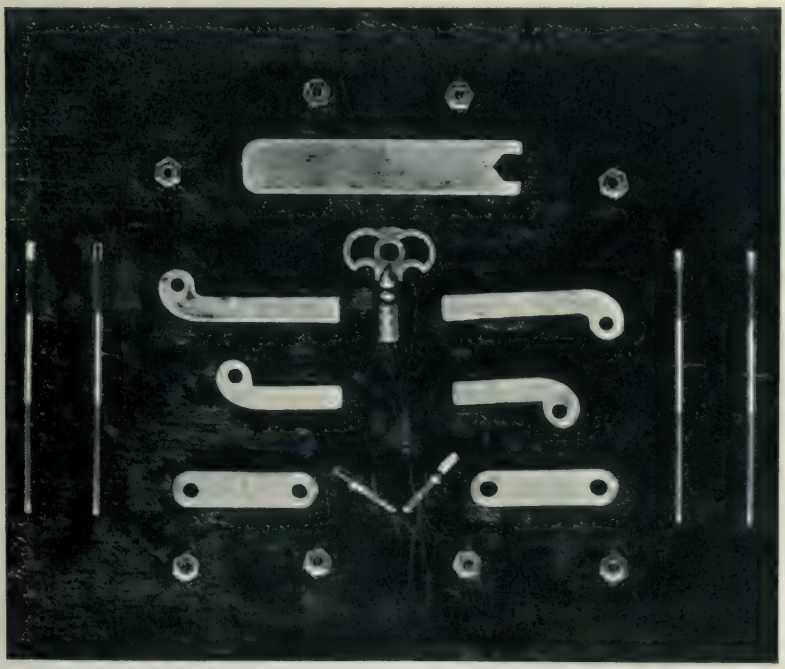


Top view of clamp in tibia.



Clamp for fractured neck of femur.

Clamp ready for removal at first dressing, end of six weeks.



Separate pieces of clamp.

SURGICAL TREATMENT OF TUMOR OF THE LIVER.

With Report of a Case.

By JOHN WHEELOCK ELLIOT, M.D.,
BOSTON.

Excision of a portion of the liver for alveolar sarcoma. The patient, a woman, forty years old, entered the Massachusetts General Hospital in March, 1896. Six months before entrance she complained of a pain radiating from the groin; and four months before entrance noticed a tumor in the right side just below the ribs. She had lost weight, strength, and appetite; had never been jaundiced.

She was thin and of a whitish-yellow color, but in fairly good condition. In the right side was a hard tumor extending from the right lobe of the liver down nearly to the crest of the ilium and over to the median line. It was movable from side to side, but less so up and down. There was doubt as to its following the respiratory movements. It seemed to be adherent to the abdominal wall, but the skin was not involved. It was very hard, but not tender. With one hand in the loin and the other in front the tumor could be grasped and moved about. The upper line of liver dulness was normal, but the lower line could not be determined on account of the tumor. Diagnosis was not definite, but lay between a sarcoma of the kidney and a tumor of the liver.

March 11th. Operation. Longitudinal incision from tenth intercostal space downward. The growth was found infiltrating the abdominal wall, and proved to be an enlargement of the right lobe of the liver near the gall-bladder. It was adherent to the intestines and omentum. After freeing it from adhesions, the tumor, the size of two fists, was cut off from the liver at its base with the thermo-cautery. The gall-bladder, with gallstones, was intimately connected, and was removed with it.

The part removed seemed to be about one-fifth of the whole liver. The wound surface was five inches long and two inches broad. Bleeding was profuse, but was controlled by pressure-forceps and gauze pressure. The cystic duct and most of the vessels were tied with silk; a few clamps were left *in situ*. The pedicle was dropped and the liver-wound was "walled off" from the peritoneal cavity by pads of sterilized gauze; iodoform gauze being packed down against the liver wound. The abdominal wound was left open on account of the gauze packing.

The patient did well, and on the fourth day all the gauze was removed. Adhesions had formed so that the liver-wound was shut off from the general peritoneal cavity. This wound was then dressed with iodoform gauze daily. Bile flowed freely from a large duct. The wound healed rapidly and the patient sat up on the fifteenth day and was discharged on the twenty-first day. Before leaving the hospital it became evident that the disease was extending on the intestinal walls, which had been separated from the growth. The disease did not return in the liver, but the patient died in three months after leaving the hospital.

The following pathological report is from Dr. W. F. Whitney, of the Harvard Medical School.

The alcoholic specimen consists of an oval mass of new growth, measuring 10 by 9 by 6 cms., with rough, irregular surface of firm consistency and pale-whitish aspect. Intimately blended with different surfaces of the tumor are portions of the liver, remains of the gall-bladder, and fibrous and muscular tissue (from the abdominal wall). A study of the relations shows that the growth started in the region of the fissure of the gall-bladder, invading it from the fundus downward, leaving a small, relatively intact part toward the cystic duct filled with biliary concretions. It had also grown into the liver, destroying a portion of it, but separated by a very sharp line, to the eye, from the substance.

The section surface is at first sight homogeneous with a softened area in the centre of about 3 cms. in diameter. On closer examination, however, it is seen to be finely mottled with small irregular opaque portions alternating with more translucent ones; in places there are suggestions of fibrous bands cutting it up into illy-defined lobules.

Microscopic examination. The structure is an alveolated one, the spaces being filled with large cells, composed of a transparent body,

and large vesicular nucleus. Many of the cells have recently divided, and karyokinetic figures are abundant. The septa between the alveoli is formed of a loose connective tissue, prolongations of which can be traced as fine filaments between the cells. In places it is infiltrated with blood, and in others the corpuscles lie in a clearly defined opening, but without any wall that is differentiated from the surrounding tissue.

An occasional vessel is met with, but such could be referred to a resistant portal vein. Everywhere, to within a short distance of the edge, the growth is marked by small areas of diffusely stained cells filled with very small, deeply colored masses of chromatin (anæmic necrosis and fragmented nuclei).

The cells of the liver, at the boundary line, are atrophied and compressed, but could be traced until they gradually disappeared in the new growth. This can be detected for only a few millimetres inside of the intact liver tissue, but there in spaces in the connective tissue of the portal system. Nowhere is there any evidence of active participation of the liver cells or those of the gall-ducts in the new growth; but everywhere their *rôle* is entirely a passive one.

Diagnosis. An alveolar sarcoma, which, from its anatomical relation, started in the connective tissue about the gall-bladder.

General Remarks and Analysis of Reported Cases.

Great progress has been made in the last few years in the technique of resecting tumors of the liver, and the immediate results of such operations have been astonishingly good. The organ is so friable, so full of gaping vessels, and so evidently incapable of being sutured, that it has always seemed impossible to successfully manage large wounds in its substance. In fact, Elder,[1] in 1886, gave the mortality of liver wounds as 62 per cent. The new departure is based on the results of experiments on animals by Glück,[2] 1883; Ponfick,[3] 1890; Meister,[4] and others.

These well-known experiments showed that large pieces of liver could be removed from rabbits without destroying the animal. That in cats and dogs the removal of more than three-

[1] Arch. f. klin. Chir., B. xxxiv. p. 369.
[2] Ibid., B. xxx. H. 3.
[3] Lancet, 1891, ii. p. 1409.
[4] Ibid., 1890, i. p. 881.

quarters of the liver was not followed by any serious consequences. That not only could the animals bear the loss of a large part of the liver, but that the organ had the power of regeneration. Meister found that after three-quarters of the liver had been resected the regeneration was so rapid that it regained its normal weight in thirty-six days. The growth was by hypertrophy, and by hyperplasia of the hepatic cells. The bile-ducts and the small bloodvessels take part in the new formation.

It was found that the urea diminished in proportion to the amount of liver substance removed, but that within eleven or fifteen days the quantity of urea rose until it became normal again. Ponfick observed that the same process took place in men, but more slowly; that when the right lobe was destroyed by an echinococcus cyst there was an increase in the size of the other lobes.

Bruns,[1] in the Franco-German War, 1870, was the first to resect a small portion of liver in man. The case was of a soldier who received a bullet-wound in the abdomen through which a piece of liver the size of a nut protruded. This was successfully cut away.

In 1883 Elder[2] had collected nine such cases, all of which had recovered. Bruns also cut out a small cancerous nodule from the edge of the liver. The liver wound was cauterized and the abdominal wound closed. Recovery.

Bruns's third case is even more striking. He removed an echinococcus cyst by excising a part of the right lobe. The tumor was the size of child's head, and occupied the middle of the abdomen. The diagnosis was uncertain. On opening the abdomen the tumor was found to be an echinococcus cyst which was surrounded by liver tissue of varying thickness. The pedicle was tied in several sections with silk and cut with thermo-cautery. The bleeding from the tissue cut by the ligatures was controlled by sponge-pressure.

[1] Beiträge zur klin. Chir., 1888, B. iv. S. 181.

[2] Arch. f. klin. Chir., B. xxxiv. S. 369.

Several vessels were tied separately. The pedicle, 12 cms. by 3 cms., was disinfected and dropped. The abdomen was closed. The patient was well in nineteen days.

More or less extensive resection of liver substance in the removal of echinococcus cysts was done by Landouzy and Segond,[1] Loretta,[2] Pozzi,[3] and Ruggi,[4] all of whom stitched the liver wound to the abdominal wound. Also less extensive resections by Vohtz[5] and Tansini,[6] who stitched the liver wound together and closed the abdomen. Terrillon[7] operated in two stages, bringing the cyst outside the abdomen and strangulating the pedicle with an elastic ligature and cutting it away at a later operation. Strange to say, all these cases recovered; although the resection of liver substance was quite extensive; notably in the cases of Loretta and Pozzi.

Lius[8] was the first to remove a large, solid tumor of the liver, which proved to be an adenoma with a fibrous capsule. He found that ligation of the large pedicle did not control the hemorrhage. He, therefore, applied an écraseur and cut with the thermo-cautery. There was not excessive hemorrhage, but the écraseur cut deeply into the tissue. He therefore tried to fasten the pedicle to the abdominal wound, but the stitches tore out of the friable liver tissue, and he was forced to let it drop into the abdominal cavity. He closed the abdominal wound, and the patient died in six hours from hemorrhage from the liver wound.

Langenbuch,[9] 1887, was the first to successfully remove a solid circumscribed tumor of the liver. The patient, a woman thirty years old, had suffered pain for eight years. A tumor the size of a fist appeared in the centre of the epigastric region.

[1] Bull. de la Soc. de Chir. de Paris, 1887, t. 13
[2] Wien klin. Wochenschrift, 1888, S. 154.
[3] Gazette Méd. de Paris, June 30, 1888.
[4] Dell' Epalectomia, etc., Bologna, 1889.
[5] Annals of Surgery, 1890, xi. p. 28.
[6] British Medical Journal, 1891, i. p. 81.
[7] Bull. de l'Academie de Médecine, Paris, 1890, No. 3.
[8] Centralblat für Chirg., 1887, No. 5, p. 99.
[9] Berlin. klin. Woch., 1888, No. 3.

It was continuous with the liver and moved with respiration. The diagnosis lay between tumor of the mesentery or pancreas, echinococcus of the liver, and, possibly, a lobe of liver separated by lacing. It proved to be a constricted portion of the left lobe, weighing 370 grammes. Its ligamentous base was divided into several portions and ligated. This stump was dropped and the abdomen closed. A few hours after the operation the abdomen had to be reopened for hemorrhage. The vessels were tied and the stump returned. Recovery in four months.

Since Ponfick's article in 1890 a number of operations for various kinds of hepatic tumors have been done, and these operations have been done by various methods. I have found forty-six reported cases where more or less liver substance was resected for tumor, and my conclusions are based on an analysis of these cases. Nine cases were for echinococcus cysts, and have already been referred to. There are several other cases not included here. They were all successful, and this fact suggests that the proper treatment of echinococcus is its excision with the invaded liver substance.

Nine cases were for syphilitic nodules. They were done by Wagner, Lauenstein, Tillmans, Hochenegg, J. B. Schmidt, Bastainelli, Mikulicz, Abbe, Albert. Two died, one by Wagner,[1] from hemorrhage, and one by Lauenstein,[2] from sepsis. On account of these two deaths and the favorable results from constitutional treatment, Segond and Bergman advise against operating on syphilitic tumors of the liver. The other cases, however, were very satisfactory, especially Bastainelli's, referred to by Kousnetzoff.[3] His patient, a woman of thirty-seven years, had complained of pain for eight months. The liver was normal in outline. A tumor on the right side seemed connected with the kidney, could be easily moved to the right, and followed the respiratory movements. The diagnosis was a new growth of the kidney.

The operation revealed a tumor, as large as two fists, fixed

[1] Beilage zur Centralb. f. Chirg., 1890, 568.
[2] Ibid., S. 73.
[3] Revue de Chir., 1896, No. 12; Policlin., 1895.

by a base, three fingers thick, to the under surface of the liver. The pedicle was tied with an elastic ligature and fastened into the abdominal wound with stitches and two long needles. The tumor was then removed and hemorrhage controlled by pressure and the thermo-cautery. The tumor weighed 750 grammes. The elastic ligature was removed on the fourteenth day. The patient was in perfect health one year after the operation.

It will appear later that the deaths reported by Wagner and Lauenstein were due to a faulty technique, and should not therefore be used as a final argument against operating on syphilitic tumors. From an examination of the other cases, it appears that old, troublesome, syphilitic nodules, which have resisted constitutional treatment, are proper cases for operation, because it offers a fair chance of relief.

Eight cases have been operated on for cancer; they were done by Bruns, Hochenegg, Lüke, Küster, Jacobs, Watson, M. Robson, Heidenhain. One case by Küster[1] died from septicæmia. In Watson's[2] case the disease recurred in two months. In Jacobs's[3] case recurrence in seven months. In Hochenegg's[4] case there was no recurrence after eight months.

In Lüke's[5] case there was no recurrence after two years. The patient was a woman thirty-one years old. The tumor, size of a fist, started two finger's breadth below the ziphoid process. It was quite movable. Diagnosis of probable liver tumor was reached. At the operation a cancer of the left lobe of the liver appeared. It was connected with the liver by a pedicle 20 cms. in circumference. This pedicle was fastened into the abdominal wound and surrounded by iodoform gauze, over which was placed an elastic ligature to strangulate the tumor. Three days later a tighter ligature was put on. After nine days the remaining pedicle was cut with thermo-cautery.

Of course, only primary cancer in a single nodule is suitable

[1] XXII. Kongress der deutschen Chirurgen.
[2] Boston Medical and Surgical Journal, Septemher, 1896.
[3] Arch. de tocol. et de gynec., 1891, No. 10.
[4] Wien. klin. Woch., 1890, No. 32.
[5] Centralb. für Chirurg., 1862, S. 844.

for operation; also primary cancer of gall-bladder which has extended to liver substance. Such were the cases of Hochenegg, Watson, Robson, and Heidenhain's.[1] The latter excised a cancerous gall-bladder with a wedge-shaped piece of infected liver 10 by 12 cms. The liver wound was packed with gauze. Recovery. Lüke's case is astonishingly favorable, and I think should lead to a further trial of excision of primary cancer of the liver.

Four cases were for sarcoma. They were by Bardeleben, Sklifossowsky,[2] Israel,[3] and Elliot. Israel removed a sarcoma weighing 1225 grammes from a girl of fifteen. Israel's and Elliot's cases died in four months with recurrence. Bardeleben's[4] case was known to be well two years after the operation.

If, then, we consider all the malignant cases together, we have twelve cases operated on with one death, and two patients were known to have no recurrence of the disease after two years. This is certainly a more encouraging beginning than could have been expected.

There are four cases of adenoma operated on by Lius, Bergman,[5] Tricomi,[6] and Goubé.[7] Bergman's case was of a man, sixty-one years old, who had noticed an abdominal tumor for one month, which was evidently growing. He suffered loss of appetite and from a feeling of pressure. The tumor could be felt in the middle of the abdomen. It was hard and smooth and of about the size of a child's head. It was quite movable, especially from side to side. The diagnosis lay between an echinococcus cyst and a tumor of the kidney. At the operation it was found connected with the left lobe of the liver by a pedicle 12 cms. broad and 2 cms. thick. A part of the pedicle was cut and an attempt was made to sew Glisson's capsule, but the stitches cut out. The large vessels were therefore secured separately with much trouble. The bleeding from the small vessels was controlled by gauze pressure and thermo-cautery.

[1] Deut. med. Woch., 1897, No. 4.
[2] Annals of Surgery, 1891, p. 151.
[3] Deutsche Medic. Woch., 1894, No. 43.
[4] XXII. Kongress der deutschen Chir.
[5] Archiv für klin. Chir., 1893, vol. xlvi.
[6] British Medical Journal, June 16, 1894.
[7] Revue de Chir., 1895, No. 7, report by Koumetzoffe.

The liver was dropped into the abdomen and the wound surface packed with strips of iodoform gauze, the ends of which were brought out through the partly closed abdominal wound. Good recovery.

The tumor proved on examination to be a rare specimen of adenoma, which is on the border-line of cancer. Goubé's case returned eleven months after operation with every appearance of cancer of the liver.

Six cases of cysts of the liver have been operated on by König, Müller, Keen, and, according to Bergman, Terrillon, North, and Lius. König's[1] patient was a girl eleven years old. There was an enormous abdominal tumor which fluctuated and pushed the liver up. The operation disclosed a cyst containing three litres of brown fluid (cholesterin) growing from the liver and partly covered with liver substance. The large liver wound was closed by sutures. The patient was known to be well one year later. The tumor consisted of numerous cysts, large and small, lined with cylindrical epithelium.

Keen's[2] case was of a woman thirty-two years old, who had had a lump in the right side of the abdomen for two years. It had increased rapidly since pregnancy three months previous. Pain, excessive discomfort, and general bad health. Tumor size of fist in right side, in the situation of the kidney, separated from liver dulness by an area of tympanitic resonance. Tumor quite movable and moderately tender. Diagnosis, floating diseased kidney. At operation a cystic tumor of the liver was found involving its extreme right border. It was removed by thermo-cautery and enucleation with the fingers, the large vessels being tied separately. The liver wound was closed with sutures and the abdomen closed with drainage-tube. Recovery. Tumor consisted of cysts of various sizes lined with cylindrical epithelium originating from the bile ducts. It was called an adenoma.

Besides the above groups there are a few cases which cannot

[1] Lehrbuch d. Speciellen Chir., 1889, S. 223.

[2] Boston Medical and Surgical Journal, 1892, vol. cxxvi. p. 405.

be classified. Tiffany[1] removed a nodule containing a small amount of fine biliary calcareous matter from the convex surface of the liver; cavity cauterized. Recovery.

Eiselberg[2] operated on a cavernoma hepatis, a unique case. The patient, a woman fifty years of age, had had a tumor near the ribs on the right side for five years, which had become painful in the last few months. It was the size of two fists. It was movable, especially from right to left. It was continuous with the liver (by palpation), but percussion showed a zone of tympany between the liver and the tumor. Diagnosis uncertain, but thought to be a kidney.

At the operation an attempt to cut across the base of the tumor had to be abandoned on account of dangerous hemorrhage from the porous tissue. Section was finally made in the sound tissue of the liver with the thermo-cautery. The vessels were tied separately and the flaps of the wound were stitched so as to greatly diminish the wound surface. The wound was packed with iodoform gauze. Recovery. The tumor weighed 470 grammes and was composed of spongy hepatic tissue full of blood.

Dr. Keen (case not yet reported) has successfully removed an angioma by elastic constriction external to the abdominal wall.

Rosenthal,[3] according to Kousnetzoff, operated successfully on an angioma fibromatodes of the lobus Spigelii. Pedicle secured by an elastic ligature held by a needle.

From an analysis of these forty-six cases it appears that only four died, giving a mortality of less than 10 per cent. The tumors have varied in size from a small nut to three fists. In Israel's case the tumor weighed 1225 grammes.

Symptoms and Diagnosis. The symptoms were not usually characteristic or suggestive. The patients were often in a debilitated condition, and many complained of pain in the region of the tumor. They often noticed a sense of weight and fulness in the right side. Several suffered from gastric disturbances

[1] Maryland Medical Journal, 1890, No. 23.

[2] Wien. klin. Wochen., 1893, No. 1 [3] Gaseta Ckarska, 1894, No. 45.

and even vomiting, probably due to pressure on or adhesions to the stomach. The tumor varied considerably in its situation according as it arose from the different liver lobes, a tumor of the right lobe being found in the right loin, in the kidney region, while a growth from the left lobe appeared in the middle of the epigastric or umbilical region.

The tumors were quite movable, even when connected by a broad base, and usually more so in a lateral direction than up and down. They almost all moved with the respiration. By palpation a direct connection with the liver was occasionally made out, but in more than half of the cases percussion showed a tympanitic zone between the tumor and the liver.

The diagnosis was made in only a few cases. These tumors were mistaken for tumor of the pancreas, mesentery, omentum, pylorus, colon, ovary, and kidney. A tumor of the right lobe can often be grasped with one hand in the loin and the other in front and moved about freely; under such circumstances it may feel exactly like a kidney, as in my case; but when, in addition to this, the urine contains casts, renal epithelium, etc., as in Keen's case, an error in diagnosis is inevitable.

Operative Technique. In the majority of the cases reported the liver substance was cut with the thermo-cautery and the large vessels tied. In a few cases the knife or scissors was used. Keen enucleated the tumor with his finger-nail. In several cases the stump was strangulated with an elastic ligature or tied in sections with silk. Gauze pressed against the wound was often effective in stopping the general oozing.

Israel, in operating on a large sarcoma, found that gauze pressure did not control the bleeding; he, therefore, wound an elastic tube twice around the whole right lobe, which completely stopped the hemorrhage. He then passed three compressing ligatures of stout silk through the whole thickness of the right lobe. This drew the tissues pretty firmly together.

There are four methods of treating liver wounds:

I. Closing the abdomen after stopping the bleeding and sewing the liver wound when possible and dropping the stump. Intra-peritoneal.

This method was followed by Bruns, Langenbuch, Wagner, Lius, Votz, Keen, and others. Lius's and Wagner's cases died of hemorrhage, and Langenbuch's case was only saved by re-opening the abdomen and retying the vessels. This, then, is evidently a very unsafe method except, possibly, for small tumors.

II. Operation in two sittings. Extra-peritoneal. Tillmans fixed the liver to the abdominal wound and destroyed the growth with the thermo-cautery.

Lüke fastened the pedicle into the abdominal wound and surrounded it with an elastic ligature. It was cut away on the ninth day with cautery. Terrillon used the same method.

Lauenstein operated in two stages, and the patient died on the twelfth day of septicæmia. Küster reports a death from septicæmia due to this method.

III. Fixing the stump into the abdominal wound. Extra-peritoneal. In many cases (cited above) the stump having been tied in sections, or even with an elastic ligature, was sewed into the abdominal wound and allowed to granulate under an iodoform-gauze dressing.

Hochenegg and Rosenthal fastened the stump into the abdominal wound by transfixing it with a long needle resting on the abdominal walls. Hochenegg controlled hemorrhage by holding gauze into the liver wound by tying stitches over it.

This method has the serious defect that the liver is pulled out of its position, which may injure the organ; it also causes a constant tendency to tear out the stitches—every respiratory movement pressing directly on the wound.

IV. Liver wound packed with gauze and dropped into abdomen. Abdominal wound partly closed. Intra-peritoneal.

Eiselberg[1] first practised this method with success, and Bergman soon followed and insisted on its value. Israel, Mikulicz, and Heidenhain have also used this method with success. My own case was done by this method carried still farther, in that the abdominal wound was left wide open and the liver wound

[1] Wien. klin. Wochensch., 1893, No. 1.

completely "walled off" from the abdominal cavity with gauze. I had no knowledge of the other cases, but simply proceeded on the now well-established principle of walling off all doubtful wounds of the abdominal viscera.

It has lately been remarked that gauze packing is one of the greatest advances in abdominal surgery, and I feel certain that its use in liver wounds is going to prove of great value. In fact, it seems to me to have settled the treatment of these wounds for some time to come, if not for all time.

It appears, then, that it is unsafe to drop a large pedicle and close the abdominal wound on account of the danger of hemorrhage; that bringing the tumor out through the abdominal wound and slowly strangulating it with an elastic ligature around its base is liable to give rise to septicæmia; that fastening the pedicle into the abdominal wound may injure the liver, and it is liable to pull away on account of the cutting of the stitches.

The best procedure is to use a rubber tube for a tourniquet, if necessary; to tie all the large vessels separately, using gauze pressure for the oozing; to close the liver wound as much as possible with sutures; to drop the stump and to completely surround it with sterilized gauze, packing iodoform gauze against the liver wound, and leaving the abdominal wound sufficiently open to facilitate dressing the liver wound.

REMOVAL OF STONE IN THE BLADDER.

By W. S. FORBES, M.D.,
PHILADELPHIA.

The annexed table of 116 vesical calculi is given as an addendum to the table of 184 vesical calculi submitted in a paper to this Association at a former meeting, held at Washington, D. C., June, 1894, during the third Triennial Congress of Physicians and Surgeons. This enlarges my table of the physical properties of vesical calculi to 300.

I am greatly indebted to my friends, Dr. John G. Kerr and Dr. J. M. Swan, of Canton, China; Dr. Daniel M. B. Thom, of Mardin, Turkey; Dr. Thomas G. Morton, of Philadelphia, Pa.; Dr. H. H. Freund, of Philadelphia, Pa.; and Dr. Edmond Souchon, of New Orleans, La., for their kindness in sending me the vesical calculi embraced in the annexed table.

Since reading my last paper on the lithotrite, this instrument has been improved both in its penile and vesical end and in its handle mechanism.

The female jaw has been made wider laterally and thinner in a fore-and-aft direction, thereby enabling it to seize the calculus or fragments more easily. The side flanges forming the depression in the female jaw have been given a greater outward flare, making the depression shallower and more obtuse in its angle. The contour of the proximal surface of the female jaw, however, has been retained as in the former instrument. The proximal surface of the male jaw is still made in the form of a wedge of about 60° in order to penetrate a calculus with the least power propelling it, but the cross ridges have been placed nearer together, and three are now used instead of two as formerly. These cross ridges, moreover, extend laterally beyond the jaw proper, thereby making the general proximal surface larger, and enabling the instrument to seize objects more readily.

No.	Appearance of calculus.	Composition of calculus.	Diameters, in millimetres.	Volume, in cubic centimetres.	Weight, in ounces and grains.	Specific gravity (approximate).	Axis of holding between jaws of lithotrite.	Actual crushing resistance of calculus, in lbs., with Forbes' lithotrite: fracture of lithotrite and testing apparatus destroyed.	Direction of fracture to line of force applied.	Time slowly increasing pressure was applied to calculus, in minutes.	Number of fragments.	Flying fragments.	Distance fragments were thrown in inches.	Size of lithotrite used (French scale).	Impaction of lithotrite measured by increased size, in degrees of French scale.	Point of fracture in lithotrite.	Calculus lasted by
183	Smooth	Uric acid, phosphate of lime outside	48-30-28	27. 6	1–180	1. 569	Short	298¼	Radiating	16	4	4	60	30	None		Dr. J. G. Kerr, Canton, China, and Dr. J. M. Swan, Canton, China.
186	" "	Uric acid	60-52-30	72. 5	3–161	1. 472	"	204½	Coincident	31½	2	None	None	30			
187	" "	Uric acid, phosphate of lime outside	27-22-18	8. 7	0–138	1. 644	"	270	Radiating	"	3	2	24	30			
188	" "	Uric acid and urates	31-20-18	6. 8	0–150	1. 470	"	141	"	1	6	None	None	30			
189	" "	Urate of ammonia	60-41-35	47. 5	1–302	1. 223	"	301½	Coincident	½	2	"	"	30			
190	" "	Uric acid	33-24-16	17. 2	0–149	1. 379	"	116	Radiating	1	6	"	"	30			
191	" "	Uric acid	31-20-18	7. 1	0–155	2. 015	"	183	Coincident	3	3	"	"	30			
192	" "	Uric acid, phosphate of lime outside	44-27-26	16. 3	0–365	1. 451	"	201¼	"	4	2	"	"	30			
193	" "	Uric acid, phosphate of lime outside	47-37-30	30. 5	1–102	1. 498	"	251	"	6	2	"	"	30			
194	" "	Urates, phos., lime and oxal. lime, stone white	41-34-24	24. 3	1–91	1. 566	"	100	"	½	2	"	"	30			
195	" "	Nucleus uric acid, body carb. and phos. lime	47-33-28	15. 3	0–455	1. 982	"	78	"	1	2	"	"	30			
196	" "	Uric acid	33-24-20	15. 6	0–330	1. 392	"	63	"	½	2	"	"	30			
197	" "	Nucleus uric acid, body phos. lime	30-26-23	9. 7	0–291	2. 000	"	107	"	1¼	3	"	"	30			
198	" "	Nucleus uric acid, body phos. lime	72-45-31	50	2–123	1. 444	"	405	"	9	Many	"	"	30			
199	" "	Urate of ammonia	49-37-28	29	0–450	1. 055	"	81½	"	1¼	2	"	"	30			
200	" "	Nucleus uric acid, body urates	50-37-32	24. 5	1–60	1. 442	"	162	"	3	2	"	"	30			
201	" "	Urate of ammonia	50-40-28	27. 5	1–84	1. 246	"	43	"	¼	2	"	"	30			
202	" "	Uric acid and urates	54-47-30	40	1–471	1. 585	"	177	"	2¼	2	"	"	30			
203	" "	Uric acid and phos. lime	36-34-25	17. 4	0–947	1. 329	"	251	"	3½	2	"	"	30			
204	" "	Urate of ammonia	54-37-28	29	1–84	1. 250	"	39½	"	½	2	"	"	30			
205	" "	Urate of lime, body carb. and phos. lime	35-34-20	8. 5	0–213	1. 670	"	251	"	1¼	2	"	"	30			
206	" "	Nucleus uric acid and oxalate of lime	34-28-22	12. 5	0–276	1. 472	"	177	Radiating	2¾	6	"	"	30			
207	" "	Uric acid	60-50-36	71. 5	3–248	1. 573	"	139	Coincident	1¼	Many	"	"	30			
208	" "	Urate of ammonia	46-46-22	18. 5	0–392	1. 412	"	128½	"	1½	2	"	"	30			

209	Smooth	Large nucleus of mixed urates, body mixed phos.	86-45-37	87	3-475	1.471	Short	231	Coincident	2¼	Many	None	None	30			
210	"	Nucleus oxal. lime with urates, body uric acid	41-24-29	13.4	0-346	1.721	"	207¼	"	2	2	"	"	30			
211	"	Large nucleus of mixed urates, body mix. phos.	68-49-42	81.5	3-294	1.418	"	188	"	3	Many	"	"	30			
212	"	Uric acid . . .	51-41.24	31.4	1-342	1.745	"	288	"	2½	"	"	"	30			
213	"	Uric acid and urate am.	43-31-24	20	0-461	1.556	"	144	"	1	3	"	"	30			
214	"	Uric acid . . .	56-43 26	34	1-381	1.68-	"	396	"	8	2	"	"	30			
215	"	Urate of ammonia .	34-28-15	7.7	0-169	1.462	"	63	Radiating	1¼	Many	"	"	30			
216	"	Uric acid . . .	40-37 23	20.5	1-61	1.769	"	141	"	1½	"	"	"	30			
217	"	Nucleus oxalate lime, body uric acid	40-38.22	16	0-422	1.758	"	210	"	5½	"	"	"	30			
218	"	Nucleus uric acid, body oxalate lime	34-30-22	12	0-343	1.950	"	321	Coincident	3	2	"	"	30			
219	Granular	Xanthine and uric acid	31-31-28	12.6	0-288	1.525	"	63	"	½	Many	"	"	30			
220	Coral	Urate and oxalate lime	50-42-30	33.5	1-370	1.930	"	251	"	3½	3	"	"	30			
221	Smooth	Uric acid, phosphates mixed outside	38-34-25	15.7	0-369	1.567	"	221	"	1¼	2	"	"	30			
222	"	Urate of lime . .	43-34-32	24	1-229	1.969	"	186	"	2	3	"	"	30			
223	"	Nucleus uric acid, mixed phos. outside	40-30-22	12.5	0-325	1.722	"	210	"	2	2	"	"	30			
224	Granular	Oxalate lime, carb. lime outside	33-29-25	11.5	0-311	1.892	"	138	"	1	2	"	"	30			
225	Smooth	Uric acid body, mixed phosphates outside	42-24-18	13.2	0-200	1.010	"	93½	"	1	3	"	"	30			Dr Daniel M.B. Thom, Mardin, Turkey.
226	"	Uric acid, urate sodium	41-26-18	10.7	0-259	1.613	"	113	"	1½	Many	"	"	30			
227	"	Uric acid, phos. lime and oxalate lime	24-23 23	6.4	0-184	1.916	"	165	Radiating	2¼	4	1	18	30			
228	"	Uric acid . . .	32-27 20	8.4	0-241	1.674	"	113	"	2	4	None	None	30			
229	"	Uric acid, carb. and phos. lime	35-29-18	7.7	0-161	1.393	"	103	Coincident	1	Many	"	"	30			
230	Mammillated	Uric acid, body uric acid & oxal. lime stone-white	31-25-20	8.1	0-195	1.531	"	153	"	1½	4	"	"	30			
231	Smooth	Uric phosphates and uric acid	50-22-21	10.5	0-190	1.206	"	74½	Radiating	1	Many	"	"	30			
232	"	Uric acid and urate of ammonia	33-27-20	9	0-249	1.622	"	131	"	1½	"	"	"	30			
233	"	Uric acid, oxal. and phos. lime	32-23-19	6.3	0-147	1.555	"	90	"	1	4	"	"	30			
234	Mammillated	Uric acid and oxal. lime outside	25-20-15	3.7	0-86	1.549	"	46½	"	½	Many	"	"	30			
235	Smooth	Uric acid . . .	34-26-18	8.2	0-192	1.560	"	128½	"	2	5	"	"	30			
236	"	Oxal. lime, uric acid, outside	27-20-13	4	0-99	1.490	"	90	"	1	Many	"	"	30			
237	Granular	Uric acid and urates .	33-20-18	5.9	0-130	1.468	"	188	"	2½	3	"	"	30			
238	Smooth	Uric acid, oxal. and phos. lime	29-25-20	7	0-176	1.676	"	188	"	2	4	"	"	30			
239	Mammillated	Nucleus uric acid, body phos. lime	29-27-16	6.3	0-190	2.040	"	248½	"	3¾	Many	"	"	30			
240	Smooth	Nucleus urate lime, body carb. lime	33-21-16	5.3	0-105	1.320	"	46½	Coincident	½	"	"	"	30			

None

None

No.	Appearance of calculus.	Composition of calculus.	Diameter, in millimetres.	Volume, in cubic centimetres.	Weight, in ounces and grains.	Specific gravity (approximate).	Axis of holding between jaws of lithotrite.	Actual crushing resistance of calculus, in lbs., with Forbes' lithotrite; friction of lithotrite and testing apparatus deducted.	Direction of fracture to line of force applied.	Time slowly increasing pressure was applied to calculus, in minutes.	Number of fragments.	Flying fragments.	Distance fragments were thrown in inches	Size of lithotrite used (French scale).	Impaction of lithotrite measured by increased size, in degrees of French scale.	Point of fracture in lithotrite.	Calculus loaned by
241	Smooth	Nucleus urie acid, body triple phos.	33-20-16	4.7	0-169	1.546	Short	186	Coincident	1½	Many	None	None	30	None	None	Dr. Daniel M.B. Thom, Mardin, Turkey.
242	"	Urate of sodium, body earb. lime	33-15-15	3.6	0-81	1.580	"	46½	"	¼	2	"	"	30	"	"	
243	"	Urates mixed and phosphates.	28-22-14	5.1	0-116	1.593	"	97	Radiating	1½	3	"	"	30	"	"	
244	"	Urie acid, earb. lime and triple phos.	28-20-19	4.8	0-111	1.588	"	165	Coincident	2	Many	"	"	30	"	"	
245	Nodulated	Nucleus urie acid, body oxal. lime	23-20-17	3.4	0-98	1.921	"	251	Radiating	2	3	"	"	30	"	"	
246	Smooth	Urie acid	28-20-13	4	0-94	1.566	"	87	"	1	3	"	"	30	"	"	
247	Nodulated	Oxalate of lime	23-21-17	4.1	0-101	1.642	"	90	"	1	Many	"	"	30	"	"	
248	Smooth	Phos. and earb. of lime, little urie acid	31-20-20	9	0-198	1.466	"	128½	Coincident	1¾	"	"	"	30	"	"	
249	"	Nucleus and body urie acid, phos. lime outside	22-24-16	7.4	0-166	1.495	"	141	"	1	"	"	"	30	"	"	
250	"	Nucleus and body urates, urate magnesia outside	27-20-17	5.1	0-126	1.647	"	32	Radiating	¼	"	"	"	30	"	"	
251	"	Nucleus urie acid, phosphates outside.	17-10-8	0.4	0-16	2.066	"	27	"	¼	"	"	"	30	"	"	
252	"	Urie acid	26-16-11	3.4	0-56	1.698	"	97	"	1	"	"	"	30	"	"	
253	Granular	" " and phos. lime	22-16-15	2.4	0-55	1.527	"	59½	"	1	"	"	"	30	"	"	
254	Smooth	Mixed urates	25-20-13	3.1	0-73	1.569	"	74	"	¾	"	"	"	30	"	"	
255	Dumb-bell	Urie acid and triple phos.	25-16-13	3.1	0-84	1.576	"	32	Coincident	¼	"	"	"	30	"	"	
256	smooth	" " "	22-16-13	2	0-48	1.600	"	63	Radiating	½	4	"	"	30	"	"	
257	Smooth	" " "	27-20-13	3.3	0-87	1.757	"	81½	"	1½	Many	"	"	30	"	"	
258	"	" " "	26-20-16	4.6	0-94	1.952	"	93	"	1½	"	"	"	30	"	"	
259	"	Urate of lime	18-11-8	0.5	0-24	3.260	"	46½	"	½	"	"	"	30	"	"	
260	"	Urie acid	25-15-10	1.3	0-35	1.794	"	87	"	1½	"	"	"	30	"	"	
261	"	" and phos. lime	16-11-9	0.7	0-19	1.809	"	90	"	1½	"	"	"	30	"	"	
262	"	" " "	19-16-11	1.7	0-54	1.933	"	63	Coincident	½	4	"	"	30	"	"	
263	"	" " "	20-14-10	1.2	0-34	1.888	"	122¼	Radiating	1	Many	"	"	30	"	"	
264	"	Urate of lime, soda, and potash.	14-11-8	0.8	0-17	1.416	"	57	"	¾	"	"	"	30	"	"	

265	Smooth	Uric acid and oxalate of lime	16-11-7	0.8	0–19	1.583	Short	43½	Radiating	¼	Many	None	None	30	None	None		
266	"	Urate of lime . .	14-11-8	0.8	0–17	1.416	"	46½	"	¼	"	"	"	30				
267	"	Uric acid . . .	18-15-9	1.4	0–32	1.523	"	63	"	½	"	"	"	30				
268	Mammillated	Uric acid and oxal. lime outside	17-15-9	1.2	0–27	1.500	"	87	"	¾	"	"	"	30				
269	Smooth	Urate of lime	12- 9-7	0.3	0–6	1.322	"	19	"	5 sec	"	"	"	30			Dr. Daniel M. B. Thom, Mardin, Turkey.	
270	"	Urate of ammonia	28 15 13	2.4	0–48	1.333	"	43	"	¼	4	"	"	30				
271	Mammillated	Uric acid and oxal. lime	16-11-10	0.8	0–21	1.750	"	78	"	½	Many	"	"	30				
272	Smooth	Ammonia, mag. phos., uric acid	28-20-13	3.3	0–71	1.434	"	60	"	½	4	"	"	30				
273	"	Uric acid and oxal. lime	14-11-8	0.6	0–14	1.555	"	131	"	1½	Many	"	"	30				
274	"	Nucleus urates, body carb. lime & mix. phos.	83-64-47	110	4–454	1.438	"	78	Coincident	1	"	"	"	30	None	None		
275	"	Nucleus oxal. lime, body carb. and phos. lime	67-60-35	57	3–180	2.842	"	186	"	1¾	3	"	"	30				
276	"	Phos. and carb. lime, little uric acid	45-27-25	12.5	0–252	1.344	"	63	"	¼	Many	"	"	30				
277	"	Triple phos., carb. lime, uric acid	33-25-21	6.5	0–176	1.743	"	46½	"	¼	"	"	"	30				
278	"	Uric acid . . .	32-25-18	8	0–180	1.550	"	87	"	½	"	"	"	30				
279	"	Uric acid mix. phos., carb. lime	37 22-20	9	0–178	1.318	"	113	Radiating	2	"	"	"	30			Dr. Thomas G. Morton.	
280	"	Uric acid . . .	35-25-15	7.5	0–162	1.440	"	90	"	½	5	"	"	30				
281	"	Urates	37-18-18	5	0–108	1.440	"	60	"	¼	6	"	"	30				
282	"	Urate and oxal. lime and mix. phosphates	39-31-24	14.5	0–362	1.698	"	188	Coincident	1	4	"	"	30				
283	"	Urate of sod. and potass. and triple phos.	25-20-13	3	0–66	1.466	"	59	"	¼	3	"	"	30				
284	"	Urates and phos. lime .	17-13-12	1	0–27	1.800	"	39	"	¼	Many	"	"	30				
285	"	Urates and triple phos.	18-12-9	0.7	0–15	1.420	"	32	"	5 sec	"	"	"	30				
286	"	Urate of lime . .	20-12-8	1	0–39	2.600	"	63	"	10 sec	2	"	"	30				
287	"	" " " . .	13-10-7	0.5	0–8	1.066	"	15	"	2 sec	Many	"	"	30				
288	"	Uric acid . . .	18-13-10	1.3	0–32	1.641	"	63	Radiating	¾	"	"	"	30				
289	"	" " . .	30-22-15	5.1	0–111	1.450	"	165	"	2	4	"	"	30				
290	"	Phosphate of lime .	41-33-20	16.5	0–338	1.365	"	24	Coincident	¼	Many	"	"	30				
291	"	Urates and triple phos., and phos. lime	44 41-32	26.5	1–133	1.542	"	144	"	1	"	"	"	30				
292	"	Uric acid . . .	47-38 27	27	1–115	1.469	"	162	Radiating	1	3	"	"	30				
293	"	Urates and triple phos., and phos. lime	55-43 30	32	1–309	1.643	"	90	Coincident	¾	Many	"	"	30	None	None	Dr. W. S. Forbes.	
294	"	Uric acid . . .	44-27-26	10	0–338	2.253	"	87	"	½	2	"	"	30				
295	"	Urates and triple phos., and phos. lime	37-36-33	20	0–463	1.543	"	165	"	2	Many	"	"	30				
296	"	Uric acid . . .	62 28 25	26.5	1–20	1.257	"	165	"	2	6	"	"	30				
297	"	" " . .	63-28-27	25	1–100	1.546	"	131	"	1¼	2	"	"	30				
298	Coral	Oxalate of lime . .	34-32-26	10	0–306	2.400	"	241	"	3¾	3	"	"	30				
299	"	Oxalate of lime and little uric acid	58-57-44	58.5	3–300	1.982	"	276¼	"	6	Many	"	"	30	None	1	"	Dr. H. H. Freund.
300	"	Oxalate of lime . .	55-43-40	40	2–73	1.721	"	336	"	5	2	"	"	30	None	"		Dr. E. Souchon.

In the handle mechanism the inside cylinder or screw-barrel has been dispensed with, and the cylindrical handle proper now carries the interrupted or segmental screw-threads. In order to separate the blades of the instrument for cleaning, inspection, etc., there is a simple lock holding the female blade to the cylindrical handle. On releasing this lock the female blade may be easily withdrawn from the male blade.

By this construction it is not necessary to slot the cylindrical handle for the withdrawal of the male blade, as is common to all other lithotrites, while having the cylindrical handle continuous and without the slot enables us to place the segmental screw-threads directly upon its inside without the use of a separate screw-barrel.

The screw-blocks are keyed to each other and to the screw-spindle by means of end keys or lugs, thus giving us a greater surface for pressure, and thereby reducing the friction of rotation.

The alligning ratchets are placed on the periphery of the screw-blocks in order to retain as large a surface as possible for pressure.

The screw-handle spindle is solid and retained in its position in the thrust-block by means of a taper pin. These changes have lightened the instrument and made it both easier to clean and more sensitive to the touch. In other respects the operation of the instrument remains as formerly.

[Note.—I am indebted to Albert N. Jacob, M.D., Demonstrator of Chemistry, Jefferson Medical College, Philadelphia, for the chemical analysis of the vesical calculi enumerated in the preceding tables.]

Successful Removal from the Bladder of a Man Thirty Years Old, of a Willow Twig Seven Inches Long, with Heavy Incrustation of Calcium Phosphate.—In the month of September, 1896, I was called in consultation in Johnstown, by Dr. A. N. Wakefield and Dr. F. Shill, to see a man about thirty years of age, who stated that he had gravel. The man showed us a small piece of willow twig, half an inch long and

about the thickness of an ordinary match, incrusted for half its length with phosphate of lime, making the mass one-quarter of an inch in diameter. He had passed this piece of twig from his bladder within a week, also two smaller pieces during the month of January last. He said that in November, 1895, he had shoved up in his urethra a long piece of willow twig, and that it had accidentally broken off at the head of his penis. As is usually the case with foreign bodies in the urethra, this willow twig had been carried by muscular action back into the bladder. The man was in a good deal of pain and could not lie down without increasing it very much. He could not retain his water longer than an hour. He had had three hemorrhages from his bladder within three weeks, and the last one was so extensive as to frighten him. On sounding his bladder the characteristic "click" was readily obtained. The "click" was observed on the right side as well as on the left side of the bladder. From examination, we concluded that the twig arched over from the right to the left side, the top of the arch being at the summit of the bladder. In consultation it was decided that I should attempt to remove the mass by crushing the lime incrustation with a lithotrite, and as far as possible to reduce the twig so as to remove the entire mass by the evacuator. If this proved impossible, it was agreed that I should perform suprapubic cystotomy.

On September 4th, in the presence of Drs. Wakefield, Shill, Wagoner, Lowman, and his son, Dr. John B. Lowman, and other medical gentlemen in Johnstown, the patient was placed under ether by Dr. Wagoner, Dr. John B. Lowman assisting. It was observed that the foreign body had not moved from its previous position. I introduced my lithotrite, a No. 18 F.[1], and readily crushed the incrustation. By screwing down the male blade it entirely severed the encased twig, which was easily cut across. The crushing of the incrustation imparted a very different sensation to my hands from that of cutting the body of the twig.

[1] Recently, six Forbes' improved new lithotrites were sent to Canton, China, through the Board of Foreign Missions. They were in size Nos. 33, 30, 27, 23, 18, 15, French. The No. 30 was tested in the testing-machine to 680 pounds and remained uninjured.

After performing this crushing and cutting for several minutes, the lithotrite was removed, and introducing a No. 25 F. canula, the evacuator drew out quite an amount of broken pieces of incrustations and a number of pieces of the twig. The operation was continued for forty-eight minutes, the bladder being washed out with a warm borated solution. The incrustations and the pieces of the twig weighed 184 grains. The pieces of twig placed end to end, by Dr. Wagoner, measured seven inches in length. The man had no untoward symptoms, was up and about in five days, and went home well in ten days.

Successful Removal from the Bladder of a Girl, Aged Sixteen Years, of a Crochet Needle, Three Inches Long. —I am indebted to my friend, Dr. C. C. Moyer, of Hazleton, Pa., for this patient, a girl aged sixteen years, short in stature, light in weight, and delicate-looking. She had been suffering from severe vesical trouble for fourteen months. Dr. Moyer said he had sounded her bladder and discovered a large vesical calculus. On March 30th last I placed her in the Jefferson Medical College Hospital. On examination there was no difficulty in confirming Dr. Moyer's statement.

Recalling that the relative frequency of stone in the bladder of men to women is four to one, a fact due, no doubt to the ease with which an ordinary nucleus can escape from the short and easily dilated urethra of the female, I expressed my surprise at finding so large a calculus in so young a girl. Dr. Moyer had asked her if at some time something could not have slipped into her bladder, but the answer was "No, never."

Remembering my patient with a willow twig seven inches long which I successfully removed from the bladder, I stated my belief that, notwithstanding the denial of the girl, the nucleus of this large stone was most probably a foreign body that had "slipped" into the bladder through the urethra.

On Friday, April 9th, the patient, having been etherized, was brought into the operating-room of the hospital, and before a large class of students and physicians the urethra was dilated, and introducing my finger into the bladder the stone was found

Skiagraph showing the protrusion of a crochet-needle from the calculus in situ.

to be a flattened oval, lodged transversely in the bas-fond. I then introduced a No. 23 Forbes lithotrite, and, grasping the stone, I attempted to lift it from its position in order to crush it, when it was found to have its poles firmly imbedded in the side walls of the bladder. Several times I seized the stone and endeavored to disengage it from its position, but could not succeed in doing so without endangering the walls of the bladder.

It was now manifest that if I opened the bladder above the pubes I would still have to divide that stone before I could safely remove its poles from their mortised position in the bladder walls. I, therefore, decided to operate through the urethra, and attempt to crush the mass near its middle, and then withdraw each extremity from its mortised position in the bladder wall. This I found was no easy matter.

The blades of my lithotrite were finally adjusted from above on the stone near its middle. In screwing down the male blade the resistance was great, and my sense of touch informed me that there was something more resisting than the stone. The impression conveyed was that the mass was becoming more condensed as I screwed down the blade. At last after great resistance the division was accomplished and the lithotrite withdrawn. On introducing my finger several small fragments of stone were felt loose in the bladder, but the two poles were still in their original position. The bladder was now washed out, and the loose fragments removed by means of a large canula and the evacuator. In placing my finger again in the bladder I found it had contracted and that the fissured surfaces of the mass were in juxtaposition: finding, however, that I could depress the right fragment below the plane of its neighbor, I introduced a female catheter beneath my finger, which was still in the bladder, and depressing the fragment on the right side of the bladder, with my finger-nail I dislodged the left fragment from its mortise and brought its pole around to and through the external meatus of the urethra. It proved to be the white-pointed extremity of a foreign body. I then seized it with a strong pair of dressing forceps, but could not withdraw it on account of a large piece of calcareous matter which projected

from its side like the fluke of an anchor. This I broke off with the forceps, and then withdrew easily a part of the foreign body, which proved to be the extremity of a crochet-needle. One large piece still remained in the original position on the right side of the bladder; I dislodged it with my finger and broke it up with a pair of forceps.

In bringing out one large piece of the crochet-needle, on which there was a projecting piece of incrustation, the external meatus of the urethra was divided to a very slight extent with a bistoury.

The bladder was then well washed out with a warm borated solution and the patient was carried to her bed.

Much of the *débris* from the crushed calculus was lost during the operation—I should say at least one-half of it; that collected weighed 315 grains. The crochet-needle was broken into seven fragments.

The patient was under ether one hour and twenty-five minutes. She walked about the ward of the hospital on the fifth day, and went home perfectly well on the seventh day after operation.

The accompanying skiagraph was taken the day before the operation by my colleague, Prof. Coplin. It is interesting to note the manner in which the exposure to the x-rays was made. By placing the patient in the supine position and arranging the Crookes tube in the manner shown in the diagrammatic sketch the rays are given such obliquity that they pass through the pelvis without meeting any bony obstruction, escaping above the os pubis (B), and below the tip of the coccyx (G), and in this way the shadow of the stone is thrown on the sensitive plate below.

I have now performed twenty-eight operations (litholapaxies) with this new instrument. The ages of my patients ranged from a child of four years to an man of eighty-two years. Of these twenty-eight operations (my first litholapaxies), twenty-five are now living and well. The three deaths were occasioned by debility and suppression. They were aged respectively fifty-eight, sixty-six, and seventy-four years. In the case of the man

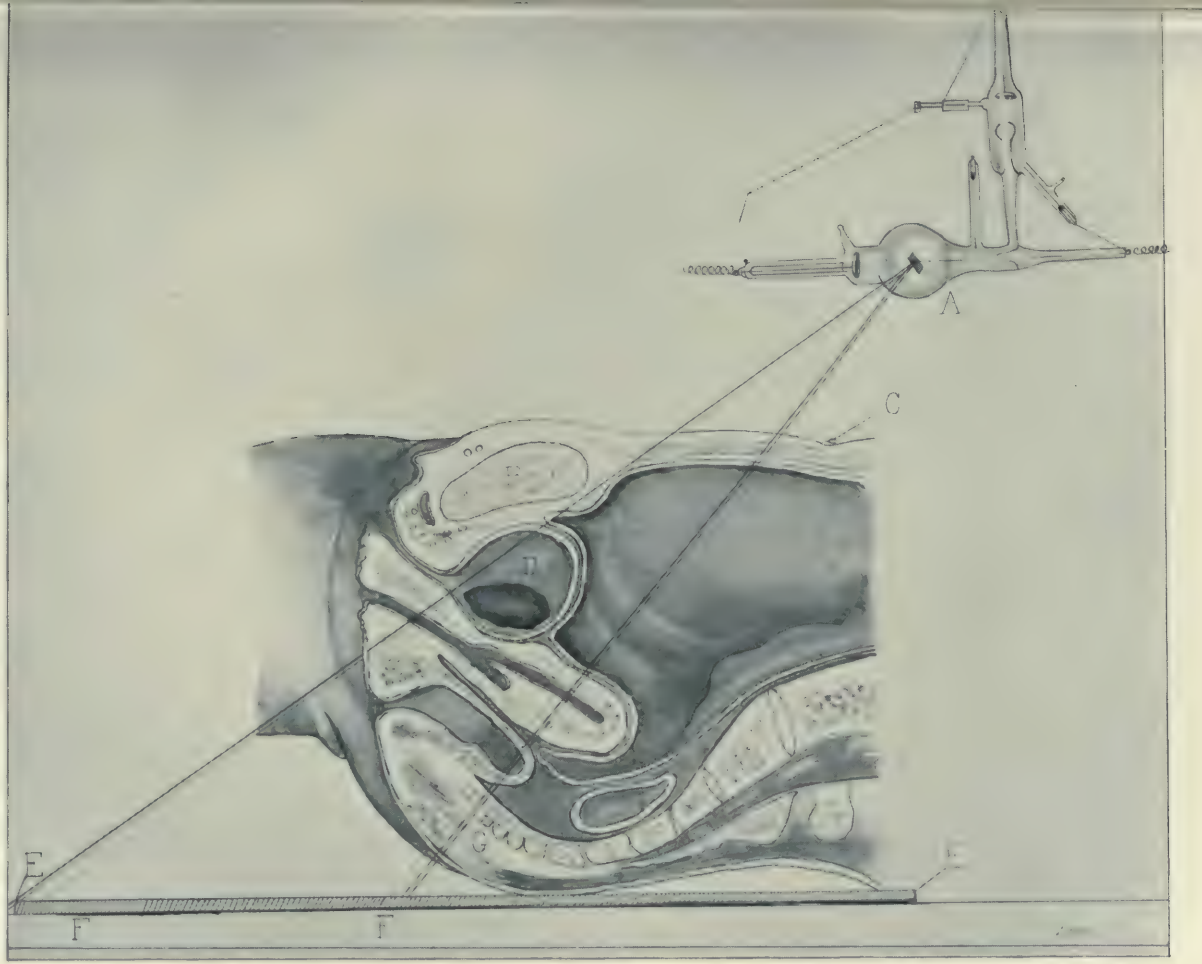


Diagram showing the relation of the X-ray tube and focus-point so arranged as to secure the shadow of the bladder-contents upon the photographic plate in an area not having any bone-shadow. A, platinum plate from which the rays are being given off; B, os pubis; C, umbilicus; D, bladder, showing contained stone; E E, X-ray plate (photographic plate) upon which, between the points F F, the shadow of the stone is projected through the floor of the pelvis in a field free from any bony obstruction; G, tip of coccyx.

seventy-four years of age, perhaps it would have been well not to have operated at all, as his debilitated condition (from alcoholism), I told him, would probably prevent his recovery; but as his sufferings were extreme, and as there was some hope for him in the operation, I concluded to extend it to him, as he wished.

In these twenty-eight cases of litholapaxy, eight of them were operated upon without ether, the bladder was always injected with four ounces of an 8 per cent. solution of cocaine just before each operation. In every case a warm borated solution was used both during and after the operation.

The smallest stone weighed 90 grains, the largest 640 grains.

Mr. Gilbert Barling, F.R.C.S., surgeon to the Birmingham Hospital, England, in the *British Medical Journal* of May 5, 1894, gives the following tables as to the comparative mortality of the three operations—suprapubic lithotomy, perineal lithotomy, and litholapaxy—in male cases under twenty years of age. This table presents the result of the practice for five years, 1888 to 1892 inclusive, in six provincial and in six London hospitals, the majority being medical schools.

It is manifest from this very carefully prepared table that the rate-mortality in suprapubic lithotomy in young males is much higher than that following perineal lithotomy and litholapaxy in this class of cases. And this opinion has since been confirmed by the recorded practice of Indian, British, and American surgeons generally.

Suprapubic Lithotomy (*Males*). Under ten years, 44 cases: 34 recovered, 10 died; ten to twenty years, 28 cases: 23 recovered, 5 died. Total number under twenty years, 72 cases with 15 deaths. Deducting 3 deaths, this leaves 69 cases with 12 deaths, a mortality of 17.4 per cent. The reason for this deduction is given in the text.

Lateral Lithotomy. Under ten years, 39 cases: 37 recovered, 2 died; ten to twenty years: 20 cases: 20 recovered, no deaths. Total under twenty years, 59 cases with two deaths. Add 1 death from suprapubic operation after uncompleted lateral, making 60 cases with 3 deaths, a mortality of 5 per cent.

Litholapaxy (*Males*). Under ten years, 43 cases: 42 recovered, 1 died; ten to twenty years, 16 cases: 16 recovered, no deaths. Total under twenty years, 59 cases with 1 death. Add 2 deaths from suprapubic operation after uncompleted litholapaxy, making 61 cases with 3 deaths, a mortality of 4.92 per cent.

Surgeon P. J. Freyer, of the Bengal Army, India, states in the last edition (1896) of his most excellent essay on the *Modern Treatment of Stone in the Bladder*, that in the government hospitals of Punjab and Bombay alone there were 7694 litholapaxies performed on patients of all ages in four years (1891–'94), with 255 deaths, or a mortality of 3.45 per cent.

In view of this experience, litholapaxy is no longer on trial. It is now a firmly established practice and destined to replace all forms of lithotomy, save in very exceptional cases.

"By litholapaxy," writes Freyer, "the surgery of the bladder has been truly revolutionized. The surgeon who would give his patients suffering from stone in the bladder the best prospect of recovery must practise litholapaxy, and, I confidently anticipate," adds this experienced and able surgeon, "that with increased perfection of the instruments employed, larger calculi than any hitherto attacked will successfully yield to the operation."

D. F. Keegan, F.R.C.S. Eng. (*India Lancet*, May 1, 1897), says: "In Punjab during the year 1895, in boys up to fifteen years of age, there were 509 litholapaxic operations, with a mortality of 2.35 per cent. During the same year there were 267 lateral lithotomy operations, with a mortality of 5.24 per cent."

In regard to suprapubic lithotomy (an operation still frequently practised here in the United States, and not limited to large stones), Surgeon Keegan states that if suprapubic lithotomy is to be adopted as a routine practice, it must be shown that it gives better results than it does now. As a matter of fact, with surgeons in India suprapubic lithotomy has made no way whatever, and, he adds, it is never likely to do so.

The mortality following the removal of stone in the bladder has, at this time, been reduced by the operation of litholapaxy by more than 50 per cent. to what it was ten years ago.

ATONIC DILATATION OF STOMACH: GASTRORRHAPHY.

By F. C. SHATTUCK, M.D., BOSTON.
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AND
JAMES H. WRIGHT, M.D., BOSTON.

Case. *Atonic Dilatation of the Stomach.*—C. W. S., male, fisherman, aged forty-seven years, Gloucester, Mass. Ward VII; bed 9. Entered Massachusetts General Hospital in care of Dr. F. C. Shattuck, January 18, 1897.

Family History. Mother died of heart disease.

Habits. No alcohol; no tobacco. Denies venereal.

Personal History. Usual children's diseases. Measles at twenty-four. "Slow fever" at nineteen for three months. No cough.

Present Illness. Beginning in 1883, he had once a year periods of vomiting, with nausea and inability to retain food on the stomach. These lasted for a week to two months and kept him from work. Attack preceded several days by gastric distress and water-brash. Would usually lose 20 to 30 pounds, which was quickly regained after stomach symptoms subsided. Each attack was worse in severity and duration than the one preceding it. For the last five years attacks have come twice a year and usually lasted a month. A year ago he was ill three months, and lost 40 pounds in weight, which returned in the next two months. He was in very good health after this until last May, when the old trouble again set in. Since then he has vomited daily, and pain and distress in stomach have increased. A few weeks ago, while out in a fishing-schooner, vomitus for a fortnight was like coffee-grounds. From that time he has done practically no work, but is not in bed. Recently, as a rule, he is comfortable during the day, but toward evening is taken with a gnawing pain in the epigastrium which gradually increases until he vomits in the middle of the night.

Then pain gradually wears away. Vomitus varies in quantity from a pint to a gallon, yellow or dark colored, very sour-smelling, often containing undigested food. Patient has marked constipation; he may have no movement for a week. Stools are occasionally black and tarry; usually not. He has eructations of gas and acids. Borborygmus. His appetite is fair. His best weight is 200 pounds; he now weighs 148 pounds.

Physical Examination. Large skeleton; cheek bones prominent. Pupils react. Tongue pale, flabby, heavily coated. Pulse strong, voluminous, and forcible. Lungs negative. Heart, small area of dulness; no murmurs. Liver, fifth rib, no edge felt. Inguinal glands of good size. Epitrochlear glands enlarged. Knee-jerks active. Stomach tympany. No tumor felt.

Urine. Normal color, alkaline, 1018.5; no sugar; no albumin; no diazo reaction. Sediment heavy; amorphous phosphates.

Blood. Reds, 3,536,000; whites, 9400. Hæmoglobin, 48 per cent.

Liquids and soft solids.

January 19th. Last night was much distressed, but did not vomit. This evening vomited thirty-seven ounces of yellow fluid. Vomitus contained HCl. Digestion, leucocytosis present. 1 P.M. meal; whites 9550, 4.30 A.M. whites 12,800; gain of 3250.

20th. House diet, with care. Liquids limited to one pint daily. Stomach washed after test-meal. Capacity 3000 c.cm. HCl present; lactic present in small amount. When inflated, lower border nearly reaches pubes.

21st. Stomach washed every morning before breakfast.

22d. Residue before washing, ten ounces

23d. Residue before washing, three ounces.

24th. Residue before washing, twelve ounces.

25th. Residue before washing, thirteen ounces.

27th. Residue before washing, none. Vomited in night.

29th. Residue before washing, eighteen ounces.

30th. Residue before washing, twenty-seven ounces.

31st. Residue before washing, nineteen ounces.

In evening, sodium bicarbonate for distress in stomach. Has not made much difference. Feels quite comfortable and has an appetite.

February 2d. In morning, one-half ounce magnesia sulphate (sat. sol.).

3d. Seen by Dr. Porter in consultation. He agrees with Dr. Shattuck that an operation is worth the risk. Patient wishes to con-

sult his family regarding it. Discharged relieved; to return in case of decision in favor of operation.

Copy of Hospital Surgical Records.

February 15, 1897. Patient entered the surgical ward for operation. History as above, copied from medical records. Temperature 98.4°. Pulse 76. Respiration 18.

16*th.* Urine: albumin, none; sugar, none; pale, acid, 1027. Vomitus: HCl present; lactic absent.

17*th.* Case examined by Dr. Shattuck again. Stomach washed out. Dilatation same as before. No pyloric stenosis made out. Prepared for operation.

18*th.* Stomach washed out in morning. Washings clear, slight greenish tinge. Previous to operation given an enema, consisting of two ounces of salt solution, one ounce of brandy, one-twenty-fifth of a grain of strychnia; white of egg. Transferred to Ward E.

Operation. (Dr. Porter. Ether.) Incision along border of ribs on left side, which reached from middle line just below ensiform cartilage to angle of ribs. Bleeding points tied with silk, and peritoneal cavity opened. Hand was introduced and stomach found immediately below incision. Pylorus palpated, and thickened mass felt in connection with it. Stomach pulled up to the incision. Some adhesions about pylorus and some about cardiac end made this very difficult. Stomach wall very slippery, and could scarcely be held, except with gauze, on account of the violent muscular contraction stimulated by manipulation. When stomach was finally pulled out pylorus was again explored. The thickened mass was apparently behind the pylorus, and not a stricture or growth about the pylorus. Few enlarged glands found. One, size of large bean, removed from the omentum; was examined immediately by Dr. Whitney and pronounced non-malignant, simply hyperplastic. As there was some doubt about mass near pylorus, an incision was made through anterior wall of stomach, which was somewhat thickened. Index finger was introduced easily through pylorus, the mass lying behind and not connected with it. The incision in stomach was closed by two rows of catgut sutures through the mucous and muscular walls, and a third row of Lembert silk sutures in the peritoneum; surface washed off with sterile water, and the gauzes which had been placed about this part of the stomach before the in-

cision, changed, the cardiac end of the stomach pulled down as much as possible, and one or two Lembert sutures placed in such a way that when drawn tight a part of the wall would be folded in. This was accomplished by making the space between the places where the suture passed into the wall of the stomach as wide as possible. Few similar sutures then placed about the middle of the greater curvature. The pyloric end of the stomach was then pulled up as far as possible and similar sutures passed. These were to be used as guides, and were so placed that when tied they would bring the line of the greater curvature as high up toward the lesser curvature as possible—perhaps one and one-half to two inches below. These guide-sutures were then tied, and the fold thus made was held invaginated while its edges were caught all the way along by a row of interrupted Lembert sutures. Holding the stomach during the last part of the operation was extremely difficult, as its muscular contraction seemed to have been excited by the manipulations. After the suturing stomach was allowed to retract into the abdominal cavity. No bleeding. Incision closed by double headers of silk through peritoneum, muscle, and fascia, and by a continuous silk stitch in the skin. Dressing, swathe. In good condition.

Incision below ribs. Pylorus explored by finger through incision in anterior wall of stomach. No stricture. Anterior wall invaginated and sutured. Gastrorrhaphy. Abdominal wall sutured in two layers.

As soon as in bed, enema. Coffee, brandy āā ℥ij; salt ad. one pint. During afternoon, subcut. strychnia, gr. $\frac{1}{40}$. Visited by Dr. Porter in late afternoon, who ordered morphia, gr. $\frac{1}{8}$ by subcut. Patient to have absolutely nothing by mouth. Enema every six hours. Beef juice, peptonized milk ℥j, egg albumin ℥j, whiskey, and salt sol. āā ℥ss. Suds and glycerine enema every morning to clean out rectum.

19th. Urine: first after ether, albumin, none; sugar, none; 1025; acid; slight increase in color. Morphia gr. $\frac{1}{4}$ subcut. last night. Patient fairly comfortable. Whiskey omitted from enemata, as pulse good. Chloral gr. xv, bromide gr. xx in night enema.

20th. Complains of feeling nervous, otherwise doing nicely. Has had no vomiting since operation, not even during recovery from ether. Spits up a little today. Morphia gr. $\frac{1}{8}$ subcut. and bromide gr. xxx at 9 P.M. Enema. Seen in the evening. As patient seems to have lost ground a little, decided to start with mouth-feeding. (Food by mouth second day after operation.) ℥ss doses every half hour of either albumin-water, beef-juice, whiskey, soda-water, black coffee.

Enemata every three hours, beef-juice, peptonized milk, salt solution, āā ℥ij.

21*st*. Took nourishment well during night. Nauseated but slightly on two occasions. This morning doses increased to ℥j every half-hour. Did not retain the 9 A.M. enema. Enemata discontinued on two occasions, and after that to contain laudanum ♏v. Dressing done this morning. Incision looked well. Moist corrosive dressing.

22*d*. Had trional gr. xx. last night for sleeplessness. No nausea. This morning, 9 o'clock, enema, not retained. Twelve o'clock enema omitted, and nutritives to be continued only every six hours. In the evening, whiskey, and beef-juice omitted.

23*d*. During the night feeding gradually increased, so that this morning patient is getting ℥ij of liquids every hour.

24*th*. For a short time has been spitting up yellow extremely foul smelling sputum. Seen to-day by Dr. Shattuck, who finds trouble in bases of both lungs behind. Dulness and whispered bronchophony. Whiskey ℥j every three hours. Abdominal wound looks all right. Codeia gr. ⅛ every four hours p. r. n. for cough.

26*th*. Nine days after operation, says he feels 70 per cent. better today. Expectoration about the only thing of which he complains. Scrambled eggs and scraped beef added to diet list. Liquids increased to ℥iij every hour.

27*th*. Ten days after operation, examined by Dr. Shattuck, who finds bronchial breathing in bases of both backs more marked on right than left. Raw oysters and gruels added to diet list. Sputum has become dark-colored, rusty.

March 1*st*. Temperature subnormal in morning, quite high in evening. Whiskey increased to ℥iss every three hours. Dip toast; rice boiled; thin Irish moss blanc mange added to list according to patient's taste; blood: whites, 14,100.

2*d*. Urine: albumin, very slight trace; sugar none; 1027; acid; no bile; color high. Few polynuclear cells; small medium-sized round cells. Occasional blood globules. One or two dubious hyaline casts.

3*d*. Sputum decreasing somewhat in amount; still rusty. Dr. Shattuck finds that consolidation is unchanged. Whiskey increased to ℥ij every three hours. Some distinctly bloody expectoration. Blood, 4 P.M.: whites, 23,900.

4*th*. Temperature going up. For some days evident that pulse steadily rising. Today probable that patient will die. Codeia

omitted. Sol. morphia ʒss every four hours to keep patient comfortable. In the evening oxygen begun. Strychnia by subcut., later gr. $\frac{1}{60}$ every three hours, which later was increased to gr. $\frac{1}{30}$. Expectoration had decreased in amount.

5*th*. Patient fairly comfortable. Died at 10.40 A.M., fifteen days after operation. The pictures illustrating the steps of the operation are copied from Bircher from *Correspondenz Blatt für Schweizer Aertze*, vol. xxii.

There are a few interesting points to be noticed in this case:

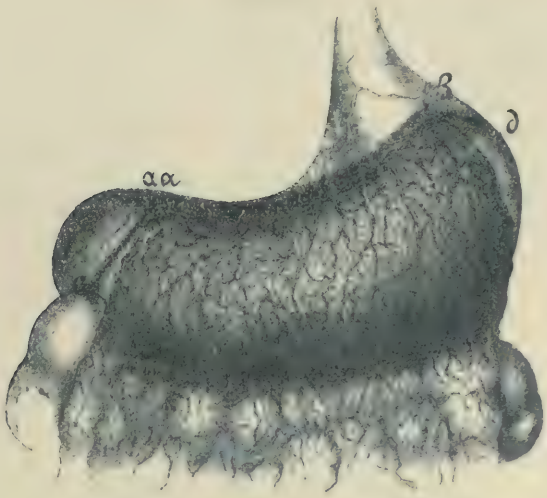
1. He died from a septic process in the lungs, yet his stomach was washed out before operation. He did not vomit at all in recovering from ether or subsequently.

FIG. 1.

Dilated stomach, showing line of fold; *a* to be sutured to *a* and *b* to *b* with intermediate sutures.

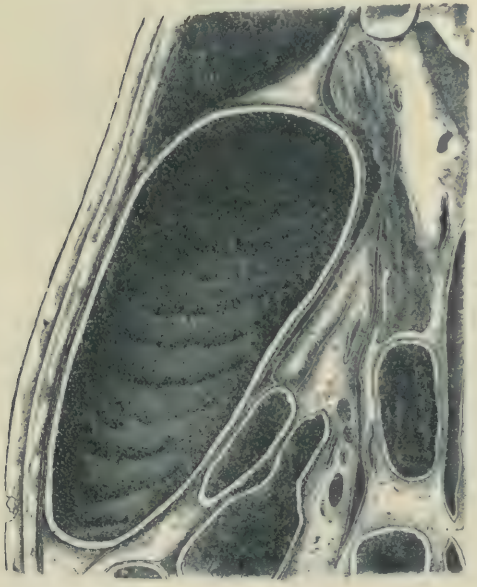
2. Food was given by the mouth on second day after operation and retained and digested. For more than a week prior to death the stomach was doing excellent work.

FIG. 2.



Operation completed.

FIG. 3.



Vertical section of dilated stomach.

The patient was so poorly nourished before operation that I think he would have failed rapidly had nutritive enemata been alone relied upon for nourishment for six days, as in previous cases.

Lastly, the abdominal wound was entirely healed and the case a success from that standpoint, the septic process not having its origin from the wounds of the abdominal or stomach-wall.

FIG. 4.

Vertical section of stomach after operation, showing infolded wall.

Autopsy. (James H. Wright, M.D., March 5, 1897.) Only those conditions copied which concern the operation field and the cause of death. Abdominal wound apparently completely healed. Some adhesions of omentum in neighborhood. Peritoneal cavity free from fluid. Intestines, especially colon in its upper portions, widely distended with gas. Serosa of intestine smooth and shining. No injection.

Stomach adherent to liver and to diaphragm by a thick fibrinous exudate. The lesser peritoneal cavity not obliterated.

Liver adherent to diaphragm by fibrinous-like strings. In the neighborhood of gall-bladder, old adhesions with colon.

In *anterior wall of stomach* there is a row of sutures along the long axis of the organ, 13 cm. long. Near pylorus a second row of sutures about 3 cm. long. No evidence of suppuration. No escape of gas or fluid on pressure.

In both *thoracic cavities* a very small amount of fluid containing yellowish shreds.

Lungs: Left lung. Superior lobe extremely pale; on section contains a moderate amount of a frothy, slightly reddish fluid. Inferior lobe largely collapsed. The inferior portion, over an area corresponding perhaps to one-quarter of the lobe near pleura, is broken down into dirty, grayish, stinking, diffluent material, rather sharply marked out from lung tissue in neighborhood.

The pleura of the inferior lobe and of the posterior inferior portion of the superior lobe covered with a fibrinous exudate, which in places is yellow, several millimetres thick, elastic, and infiltrated with fluid. The pleura in these situations firmly adherent to visceral pleura, on which a similar exudation is present, most marked over the diaphragm, apparently opposite to the gangrenous area of the lower lobe. Just beneath the parietal pleura, near the junction of the lower ribs with the spinal column, there is a half-dollar sized flattened elevation with circular outline covered with fibrinous exudate and on section composed of a red-black material resembling clotted blood. There was no perforation of diaphragm. The fibrinous exudate of pleura in places on the lung shows numerous minute vessels extending into it from the pleura.

Right lung. In superior lobe a chestnut-sized area just beneath the pleura in which the lung-tissue is broken down into a brownish-gray, diffluent, stinking material, rather sharply marked out from surrounding lung-tissue. In inferior lobe on pleura are two circular areas covered with a dirty yellowish-gray exudate, rather sharply defined and varying in size from a half-dollar to a dollar. These circular areas seem to correspond to similar circular yellow elevations beneath the parietal pleura, which on section, are made up of a dirty gray, diffluent, purulent-looking, necrotic material. They are situated in the posterior portion of the thoracic wall. A rib passing beneath one of them was excised and gave no evidence of suppuration in the intercostal or osseous tissue beneath. The areas on the pleura correspond to extensive areas of lung-tissue transformed into a brownish-gray, stinking, diffluent, gangrenous material. The areas are sharply marked off from surrounding lung-tissue. The inferior lobe is markedly col-

lapsed, its pleura and the pleura of the posterior and inferior portions of the upper lobe covered with a fibrinous exudate which in places is yellow, thick, and infiltrated with fluid. In lower lobe there is apparently some consolidation in the neighborhood of one of these gangrenous areas, the tissue being resistent, grayish, and homogeneous. The pulmonary arteries leading to the inferior lobes of both lungs were dissected, but no good evidence of embolism could be made out. Bronchi infected and contain a considerable amount of a dirty, grayish, opaque fluid.

Stomach. The long row of sutures corresponds to the infolding of the stomach wall, the short row to a wound in the stomach wall with inversion of the edges and coaptation of the serous edges. At the pylorus there is a distinct loss of substance in the mucous membrane in the form of an oval ulcer, 5 cm. long by 2 cm. wide, and perhaps 4 or 5 mm. deep. The margins smooth, to a considerable extent undermined, and the mucosa projecting over. The floor fairly smooth, with three to four polypoid projections. The edge of the ulcer reaches to within 1 or 2 mm. of the pylorus. The tissue in the neighborhood of the ulcer not especially indurated, nor is the stomach wall especially thickened about it. The pylorus admits the index finger. The stomach, as it appears with the plait in its wall, is of moderately large dimensions. The stomach-contents show no evidence of hemorrhage. The mucosa not remarkable.

Anatomical Diagnosis. Ulcus ventriculi, with dilatation of stomach. Gastrorrhaphy; gastrotomy. Circumscribed fibrinous peritonitis. Gangrene of lungs. Fibrinous pleuritis. Acute degeneration of kidneys. Chronic prostatitis.

BIBLIOGRAPHY.

Bircher. Correspondenz Blatt für Schweizer Aërtze, vol. xxii.
Weir. Transactions American Surgical Association, 1892, p. 149.

HABITUAL OR RECURRENT DISLOCATION OF THE SHOULDER.

By HERBERT L. BURRELL, M.D.,

AND

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Habitual or recurrent dislocation of the shoulder, although on the whole a surgical rarity, occurs often enough to have attracted to itself a certain amount of theoretical and practical consideration. The name "habitual dislocation" is intended to refer only to those cases where dislocation occurs from causes too slight to displace the normal joint. A person may dislocate one shoulder two or three times from a succession of severe accidents without falling into this special pathological class.

Pathology and Etiology. The pathological condition present varies widely; certain abnormalities have, however, been demonstrated, chiefly in the head of the humerus, where it has been removed by excision for the relief of the disability.

Cramer (*Berl. klin. Woch.*, 1882, p. 21) excised the head of the bone in an epileptic woman, thirty years old. The head of the humerus showed a depression in the posterior part of its articular surface. This was 4 cm. long, 2 cm. broad, and ¾ cm. deep. There was also found in the joint a loose body with a smooth surface composed of bone, fibrous tissue and cartilage, and this loose body was attached by a long pedicle to the back of the glenoid fossa. It seemed to be a piece broken out of the head of the humerus. Dislocation was apparently favored by this abnormality in the shape of the head of the bone.

Volkmann (*Cent. für Chir.*, 1883, p. 28), quoted by Popke, resected

the shoulder-joint in a man thirty years of age, an epileptic, whose shoulder slipped out with such ease that the arm was almost useless.

The posterior third of the head showed a smooth surface not covered by cartilage, and the glenoid cavity was narrower below than above. The capsule was torn away from the glenoid cavity, and the joint, therefore, communicated with the bursa under the subscapularis muscle. A loose body was also found in this joint, evidently of bony origin, and apparently due to a fracture of the glenoid cavity.

Küster (*Beil. zum Cent. f. Chir.*, 1882, p. 73) excised the shoulder in a young man whose original dislocation was produced by the fall of a heavy box on the shoulder. The head of the humerus showed a similar loss of substance, but no loose body was found in the joint.

In the discussion following the report of these cases Kraske reported a case operated on at Halle, where the changes in the head of the bone were similiar to those mentioned above, and a loss of substance existed also in the glenoid cavity.

The cases of Cramer and Küster, at least, point plainly to a fracture of a part of the joint as a cause of the recurrent dislocations, and that such injuries may occur in simple dislocations of the shoulder is attested by at least three cases (quoted by Cramer):

1. Cooper: Subspinous dislocation, subscapularis muscle torn off and attached to the glenoid fossa.

2. Hilton: subglenoid dislocation—greater tuberosity torn off.

3. Deuterlich: Both tuberosities torn off and implanted lower down on the humerus.

Löbker (*Beil. zum Cent. f. Chir.*, 1886, p. 90) reported a case, the specimen being obtained post mortem, which seems to belong to another category, and with this goes a similar case resected by Vogt. In each case the anterior part of the head was normal. The posterior half, however, was flattened and showed a depression 1 cm. deep extending from top to bottom. The surface was covered by cartilage, and neither here nor in the glenoid cavity could any evidence of a previous fracture be found. The long tendon of the biceps had been torn from its insertion and was adherent in its groove, and the muscles had apparently been torn from the greater tuberosity. It does not seem possible to attribute these malformations to fracture, as in the other cases.

Injuries to the muscles and tendons have been demonstrated by Joessel (*Deutsch Zeitschr. f. Chir.*, 1880, xii. p. 167). He had the opportunity of examining post mortem the bodies of three patients (one with a double habitual dislocation), which furnished four specimens. Analysis of these showed in all cases that the supra- and infra-spinatus muscles had torn loose from the greater tuberosity and had retracted and wasted. By the retraction of the tendons of these muscles the capsule was drawn upon and pulled open, so that it communicated with the subacromial bursa. The joint-cavity, therefore, was bounded above by the under-surface of the acromion. In one the long tendon of the biceps was ruptured and was adherent to the groove. The cavity of the joint was much enlarged, having in one case a capacity of 90 cm., where it should have been only 28 cm.

In the two cases operated by Ricard (*Bull. de l'Acad. de Méd.*, 1894, p. 330) the capsule was found to be thin, flaccid, and lax, no rent was found, nor was the joint-sac opened.

In the case operated by Gerster (*Rules of Aseptic and Antiseptic Surgery*, p. 8, note 2), and in the two cases operated by Burrell no abnormality beyond laxity of the capsule was detected, but it must be remembered that in these five cases the joint could not be as thoroughly explored and inspected as in the examination of a post-mortem specimen of a resected joint.

A consideration of this pathological evidence (Stimson: *Dislocations*, p. 265, quoting also Gurlt: *Path. Anat. der Gelenk-Krankheiten*, p. 250; Cushing: *Med.-Chir. Trans.*, 1837, p. 336) establishes the probability that in some cases at least the cause of the frequent dislocations may be

1. Laxity of the capsule of the joint.
2. Partial fracture of the head of the humerus.
3. Partial fracture of the glenoid cavity.
4. Tearing away of muscular insertions and rupture of tendons.
5. Abnormality in the shape of the head of the humerus not demonstrably due to fracture, but probably the result of chronic, non-suppurative inflammation.

It would seem as if in certain instances the cause of the re-

currence of the dislocation was insufficient immobilization of the arm after a primary dislocation. The arm should be immobilized for at least ten days in order that the rent in the capsule of the joint may close.

Symptoms and Diagnosis. Six cases are here presented for analysis, and of these four have been carefully observed with regard to certain symptoms not heretofore recorded. The other two cases occurred earlier and were not recorded in these especial symptoms.

In the four cases closely observed, three of the right arm and one of the left, the right shoulder has in all cases drooped.

Muscular Atrophy. Certain of the muscles of the affected side were so notably atrophied and flabby that they at once attracted attention on examination. The other muscles were not notably smaller than those of the other side. The group of muscles affected in these cases has been uniform and constant.

The atrophied muscles are

Coraco-brachialis.
Triceps.
Deltoid, especially the posterior part.
Supra- and infra-spinatus.
Rhomboids.
Levator anguli scapulæ.
Latissimus dorsi.

In a case observed by Lovett, where three dislocations of the right shoulder had occurred inside of a year, each from a sufficiently heavy fall, there was no marked atrophy of these muscles one week after the third accident.

Electrical examination in Cases III. and VI. showed no reaction of degeneration and no qualitative change, except in the deltoid, which was more irritable on the affected side, Case VI.

Limitation of motion was present in all cases to a slight extent, and this limitation was not due to pain nor to fear of displacement, but apparently to some lesion in the joint-mechanism. This was noticed chiefly when the arm was abducted by the patient to a right-angle with the body, and

upward swinging of the forearm was attempted. Such rotation in this position was not so free as on the other side. In three of the cases abduction of the arm was limited.

Examination by the fluorescope showed that the kathode rays penetrated the affected shoulder with more difficulty than the other, and at no time was the picture so clear. It could be seen that the head of the humerus was further from the acromion in the affected shoulder. It could be replaced and made to look like the other by raising the point of the elbow. (Cases IV. and VI.)

It should be noted that a large proportion of epileptics are found in all reported cases. Another point of interest is that, although reduction is, as a rule, easy, and inflammatory reaction in the joint is notably slight or even wholly absent after reduction, these patients have a constant and exaggerated dread of dislocation. The condition of "panic" when recurrent dislocation does occur seems to be an analogous mental condition to that of patients with hæmoptysis.

Prognosis. In a shoulder-joint where a dislocation has once or twice occurred from insufficient cause, it is not likely that the liability will become less frequent as time advances, if no treatment is undertaken. As a rule, the dislocations will occur with greater frequency and from slighter causes as time progresses.

Treatment. The methods of treatment may be classified under four heads:

1. By apparatus.
2. By massage and exercises alone.
3. By temporary fixation and massage.
4. By operation.

1. *Apparatus.* The use of apparatus confining the arm to the side is to be condemned. It weakens the muscles by causing their disuse. It is uncomfortable and partially disabling, and its use can only be considered justifiable temporarily or under exceptional conditions.

2. *Massage and exercises without apparatus.* This treatment is based on the advisability of improving the circulation and nutrition of the shoulder and strengthening the atrophied

muscles. From the observations made as to the atrophy of the muscles surrounding the joint, and the relaxation of the capsule of the joint, it is clear that any improvement in the strength of these muscles is logically called for. The shoulder is allowed perfect freedom during this treatment. Case II., treated in this way three times a week for some months, improved in outward appearance, and the muscles, although not regaining their full tone as contrasted with those of the other side, grew much firmer. Dislocations, however, occurred as frequently as before this treatment was undertaken.

Case II., on the other hand, treated for six months by the same method, has had no dislocation, having gone longer than his usual period, and the muscles of the shoulder have improved in appearance.

Exercises should be made against resistance, and should be directed to the development by special training of the atrophied muscles. Examples of such exercises would be abduction of the affected arm to contract the deltoid, backward movements from the shoulder, forcible extension of the arm for the triceps, and similar movements.

3 *Fixation in connection with massage and exercises.* Prolonged fixation is called for when a second dislocation has occurred from slight cause. The arm is lifted by applying a sling, which supports the forearm and point of the elbow. The arm is held to the side by a swathe, thus preventing all motions of the joint. This removes as much weight as possible from the joint-capsule.

In connection with this treatment, daily massage to the shoulder muscles should be employed, and especially to the muscles found atrophied in such cases. After some weeks of fixation motion should be progressively allowed along with massage and exercises for the muscles ordinarily affected in these cases. This treatment should continue at least three months. Electricity is of help also in causing special contractions of the atrophied muscles. The faradic current of medium strength should be used.

4. *Operation.* The operative measures advocated have been

few. The earliest method advised was to cause an extensive scar in the axilla, thereby binding the arm to the side.

Malgaigne (*Traité des Fractures et Luxations*, vol. ii.) advocated subcutaneous incision of the capsule of the joint by a tenotome introduced anteriorly, in the hope of producing inflammatory contraction.

Removal of the head of the humerus has been done several times with surprisingly good results as to the restoration of motion and in the matter of usefulness of the arm. Excisions for the relief of this condition are recorded[1] by Cramer, Löbker, Küster, Volkmann, Kraska, and Vogt.

Excision of the head of the humerus is a mutilating operation, and will rarely be necessary. It is conceivable that after an exploration of the joint abnormalities might be found which would demand an excision.

Cramer is recorded as alluding to an open incision of the joint as a possible operation in this condition in 1882 (*Berl. klin. Woch.* p. 21).

Gerster (*Rules of Aseptic and Antiseptic Surgery*, p. 8, note 2), in 1883, operated upon a recurrent dislocation where the weight of the arm alone was sufficient to displace the joint:

"The joint was freely opened by an anterior longitudinal incision, when it became evident that the tendency to dislocation was due to laxity or redundancy of the anterior part of the capsular ligament. By two semi-elliptical incisions a piece of the capsule one inch long and half an inch in width was removed. The capsular wall as well as the muscular- and the skin-wound was united by three tiers of interrupted catgut sutures." Suppuration occurred from improperly kept catgut; the wound was reopened and packed with gauze. No further complication interrupted the course of healing. The habitual luxation was also cured.

In 1892 Ricard (*Bull. de l'Acad. de Méd.*, 1894, p. 334) exposed the capsule of the shoulder-joint by dissection, in the case of a young man, twenty-seven years old, the subject of frequent

[1] Cent. f. Chir., 1883, p. 28; Beilag. z. Cent. f. Chir., 1882, p. 73, and 1886, p. 90; Deutsch Zeits. für Chir., 1880, xiii. p. 167; Pitha and Billroth, ii. p. 652.

dislocations of the left shoulder. He did not open the joint-sac, but reefed it anteriorly by stitches passed through its whole thickness about 2 cm. apart. Absolutely normal mobility was secured, and eighteen months later no recurrence of the dislocation had occurred.

A second case was operated on by Ricard a few months later in 1892. The patient was an epileptic, and had had some twenty-eight dislocations. The same operation was performed; restoration of joint-motion resulted, and a year after operation the shoulder had not again been dislocated.

On February 19, 1895, Burrell, through an anterior incision, opened the joint, explored it, removed an elliptical piece of the capsule, and sutured the capsule, thereby shortening it.

The history of this case is appended in Case V.

He operated upon a second case February 16, 1897. The history is appended in Case VI.

The accompanying cut, which shows the field of operation, is a drawing from a dissection kindly made to demonstrate this operation by Dr. F. B. Lund. The important detail which is shown in the cut is the divided tendon of insertion in the pectoralis major. This allows the retraction inward of this muscle, uncovering the capsule of the joint. In order to gain access to the joint the subscapularis muscle should be partially divided. Then with hooked retractors a piece of the capsule can be excised.

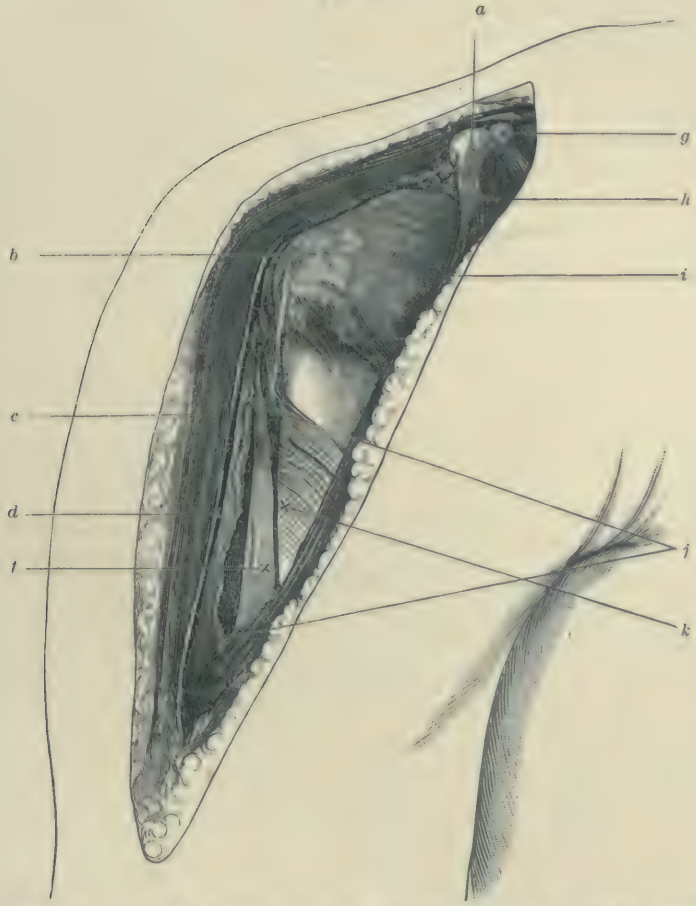
The following description gives in detail the operation:

The patient was etherized and the arm slightly abducted. An incision was made from the coracoid process downward and outward, following the line of the cephalic vein to below the upper border of the tendon of insertion of the pectoralis major. The cephalic vein was then recognized, drawn outward, and the intermuscular septum between the deltoid and the pectoralis major was separated with the handle of the scalpel and by a few touches of the blade.

This exposed in the upper part of the wound the coracobrachialis and short head of the biceps, and in the lower angle of the wound the upper part of the insertion of the pectoralis major.

The acromio-thoracic artery was identified; the upper three-quarters of the insertion of the pectoralis major was divided in order to allow the muscle to be retracted inward and thor-

FIG. 1.



a, coracoid process; *b*, subscapularis muscle covering capsule; *c*, deltoid; *d*, cephalic vein; *f*, long head of biceps; *g*, pectoralis minor; *h*, tendon of coraco-brachialis; *i*, pectoralis major; *j*, edge of divided tendon of insertion of pectoralis major; *k*, tendon of latissimus dorsi.

oughly to expose the head and neck of the bone. These now came into view, and in front of the head and neck of the

bone could be seen and felt, through its sheath, the long head of the biceps.

It was found necessary to clear the tendon of the coraco-brachialis and short head of the biceps quite up to the coracoid process, and to carry the incision in its whole depth up to the coracoid process.

By externally rotating the arm and dropping it backward the insertion of the subscapularis muscle could be distinguished, and its tendon was stretched over the head of the bone. A portion of this insertion was divided. The finger felt the head of the bone, the anterior two-thirds of which were very plainly exposed, and it tended to slip forward toward the coracoid process. The coracoid process could be plainly distinguished, and the capsular ligament was apparently lengthened.

The arm was then abducted to an angle of 45°, and the head of the bone pressed backward to prevent the head from coming up under the coracoid process. By this means the front of the capsule was relaxed. The loose part of the front of the capsule was grasped with three-pronged Vulsellum forceps. Three sutures were inserted with a curved needle beneath this, and this fold was excised, three-quarters of an inch in length and three-eighths of an inch in width of the capsule.

Two of the sutures were cut out at the time of removing the bit of capsule. The other suture was held and tied. Another suture was introduced into the capsule. After these sutures were tightened and tied it was found that the capsule was distinctly tighter and shorter.

The acromio-thoracic artery was divided and was the only vessel requiring ligature. Sterile water was used for irrigation. Silkworm-gut sutures closed the whole length of the wound. No attempt was made to unite the partially divided insertions of the pectoralis major and of the subscapularis, as when the arm was brought to the side these structures came together without suturing. The wound was dried, an aseptic dressing was applied, and the arm was fixed to the side with the hand across the chest.

The important steps in the operation are: the free division

of the tendinous insertion of the pectoralis major for three-fourths of its breadth, in order that the head of the bone and capsular ligament may be freely exposed by retracting the muscle; the division of a portion of the insertion of the subscapularis; raising the arm to a horizontal plane and pressing back the head of the bone, which relaxes the front of the capsule so that it can be grasped and a bit removed.

A clear differentiation should be made of the anatomical structures, and, with this accomplished, the operation is feasible. The use of a broad retractor, without sharp points, on the inner side of the wound to retract the coraco-brachialis and the vessels is of great importance.

The result of the operation in the first case (Case V.) is that a year and ten months after operation the patient, when seen, stated that there had been no recurrence of the dislocation; that he had been fishing on the Grand Banks during the summer of 1896, and that the motions of the joint were perfect. In the second case (Case VI.), at the end of two months, the patient is using the arm freely and has had no recurrence of the dislocation.

The first operation took one and three-quarters hour. The second operation took thirty-five minutes. It is purely an anatomical operation, and each anatomical structure must be recognized as carefully as in the ligation of an artery. So far as one can generalize from these two operations it is simple, efficient, and curative.

Conclusions. The treatment of recurrent dislocations of the shoulder-joint should be by massage and exercise, combined with primary fixation. If this fails after ten weeks' trial, an operation is advisable. This operation should be the exposure of the anterior part of the capsule of the joint, its partial resection, and shortening by sutures.

Histories of the Cases.

Case I.—A man, aged thirty years, subject to epilepsy, was seen by Dr. Lovett in 1889. The dislocation was subcoracoid, and could not be reduced without ether. It recurred frequently, and was generally

caused by epileptic paroxysms at night. The patient only remained under observation for a short time, during which time a bandage was applied, holding the arm to the side. The dislocation was apt to occur whenever the arm was raised from the side. The condition gradually grew worse, and the patient disappeared from observation, being very remiss about treatment.

Case II.—The patient, a young, healthy, but nervous man, aged thirty-two years, of fair muscular development, was seen by Dr. Lovett October 3, 1896. He had originally dislocated his arm by a heavy fall, and had been treated by an eminent surgeon.

The arm had been kept at rest about ten days, and then he had been allowed the use of it. When seen he had dislocated the arm four times, the last two being on slight provocation.

He was seen with the arm dislocated in the subcoracoid position; it could not be reduced without ether. The arm was fixed for two weeks, at the end of which time the patient became restive and was unwilling to continue fixation longer. He was warned of the consequences and was allowed the use of the hand. A few months later he dislocated it in falling down-stairs, and this time he refused to have it done up more than a few days. He experienced little discomfort from the dislocation. He was given massage and electricity, but after a few weeks felt better, and discontinued all treatment. During the summer he went abroad, and dislocated it by a fall of moderate severity.

In the fall of 1896 dislocations became more frequent, and were more easily reduced. He was treated by massage, exercise, and faradic electricity. In spite of efficient massage, given every other day for several months, the arm continued to be dislocated at short intervals, and on very slight provocation when the arm was in a position of abduction. Fixation for some weeks with daily massage was advised, but declined, and no treatment was pursued.

Case III.—A well-built and well-developed man, aged twenty-three years, medical student, consulted Dr. Lovett, November 19, 1896. Right arm had been dislocated previously at foot-ball; it was fixed for a few days, and then motion allowed. The dislocation was subglenoid, and was reduced without ether. A little later dislocation was produced by foot-ball again, and was reduced without ether. At intervals of a few months, dislocations were produced by such causes as pitching hay, throwing a stone overhand, reaching up to a hinge, and the last dislocation occurred in February, 1896, reaching out

over a horse. No dislocation has occurred for over a year, but the patient has carried his right hand in his pocket, and tries not to lift it above the level of his shoulder. At present he is being treated by massage three times a week. The muscular condition has im-

FIG. 2.

FIG. 3.

Case IV.—Showing the atrophy of certain muscles of the left arm.

proved and a wider usefulness of the arm has been obtained. Except for the continual and characteristic dread of another dislocation, the patient is little bothered. The muscles show no change in an electrical examination, and the patient can now reach above his head.

CASE IV.—Seen by Dr. Lovett, February 23, 1897. A professional

ball player. Dislocated his left shoulder October, 1894, in playing foot-ball, being kicked in the axilla. The dislocation was subcor. acoid, and was reduced under ether.

The arm was fixed for a few days; two weeks after he began using it, and used it as well as ever.

In April, 1896, he dislocated the arm again in swinging for a standing jump; the dislocation was reduced without ether. Fixation for ten days. The first of February, 1897, he fell on ice, again dislocating the arm—a subglenoid dislocation. He kept the arm quiet for ten days, and three weeks later the arm was still sore.

An x-ray examination showed that the head of the humerus was not as near the acromion as on the other side. It could be restored to place by pressing the arm upward. The capsule was obviously lax, and the humerus "dropped."

FIG. 4.

Case V.—Before operation, showing the apparent "dropping" of the left humerus.

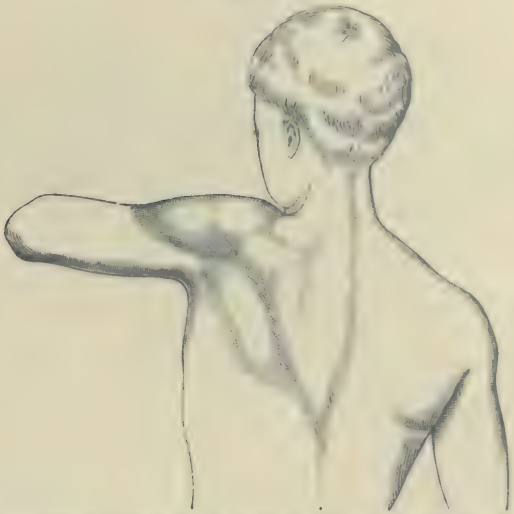
The atrophy of the muscles was characteristic. The arm was at once fixed by a sling and swathe for six weeks. Daily massage was given along with faradic stimulation of the atrophied muscles. Then the use of the arm was gradually resumed, and vigorous exercises, both special and general, were given to restore mobility and usefulness. The muscles improved much in appearance and feeling, and by the middle of April he was able to fill his place as catcher of a base-ball nine.

CASE V.—Was seen by Dr. Burrell. The patient was twenty-seven years of age, a fisherman by occupation, and whose history was as follows:

FIG. 5.

Case V.—After operation.

FIG. 6



Case V.—Showing atrophy of left scapular muscles and latissimus dorsi.

In August, 1893, fell from a staging and struck on the elbow and shoulder-joint. The dislocation was reduced by a fellow workman, and the patient remained at his work that day. There was no subsequent treatment. There have been numerous recurrent dislocations

ever since the accident. At first he used to reduce the dislocation himself and continue work, but of late the joint will not remain reduced for any length of time. Can reduce it more easily than at first. There is some pain in the shoulder.

The patient is well developed and nourished. There is a history of epilepsy. The head of the humerus can be felt apparently in its normal position. There is some atrophy of the deltoid muscle. The sulcus between the deltoid and pectoralis major is very marked, and there is some flattening of the posterior scapular muscles.

The patient requested that the arm be amputated, as it interfered so seriously with his work. The dislocation has taken place so frequently that he cannot remember the number of times it has occurred. Recently while turning in bed he has frequently dislocated the shoulder-joint.

FIG. 7.

Case VI.—Before operation; front view.

On February 19, 1895, an incision was made over the deltoid muscle, beginning at its insertion and extending up about six inches. The fibres of the deltoid were separated, and three-fourths of the tendon of the insertion of the pectoralis major was slit down to permit access to the joint. The capsule of the joint was found intact, but very loose. From the inner and anterior aspect of the capsule a piece was

removed 4 cm. long and 1 cm. broad. This opened the joint. It was explored, and so far as could be felt was normal.

The capsule was closed by catgut sutures, and the wound was closed by silkworm-gut sutures. A sterile dressing was applied, the arm being put up with the forearm flexed and the point of the elbow raised and carried inward toward the median line.

There was considerable pain after the operation, but it was controlled by morphine. Aseptic healing occurred. The arm was dressed and all the sutures removed in twelve days, but the arm was restrained by a Velpeau bandage. Massage was carried out in this case for four weeks and the patient returned to his full work at the end of eight weeks from the time of operation.

FIG. 8.

Case VI.—Before operation, showing the atrophy of the scapular and other muscles of the right side.

CASE VI.—Applied at Out-patient Department of the Boston City Hospital in February, 1896, and was operated upon by Dr. Burrell on February 16, 1897. Patient is a well developed man of medium height, thirty-six years of age, a roofer by profession. During his life has given evidence of "petit mal."

About a year ago, while learning to ride a bicycle he fell off and dislocated his shoulder. It was easily reduced and he continued his ride. Twenty minutes later he ran into a fence and dislocated his arm again. It was again reduced without ether, and was lame for some time, although no surgical treatment was adopted. Since that

time he has dislocated the arm thirty-five times. It dislocates with the greatest readiness and from very slight causes. While under observation at the hospital he was asked to raise his hands to the level of his shoulder, which he did, and in lowering them the right humerus slipped and was dislocated into the subcoracoid position; it was easily reduced by the Kocher manipulation. During the past two months he has found that on raising his arm above his head the shoulder would slip out of place. He usually reduces it himself.

FIG. 9

Case VI.—After operation, showing the cicatrix.

His right shoulder droops. There is a moderate and characteristic atrophy of the muscles about the shoulder-joint. An x-ray examination showed that the tissues over the affected shoulder did not transmit the x-rays as easily as the other. A small amount of dropping of the head of the humerus could be seen. In this second operation a good deal of care was taken to record the various steps in order that it could be presented for publication; *vide* description of operation.

OPERATIVE TREATMENT OF IRREDUCIBLE DISLOCATIONS OF THE SHOULDER-JOINT, RECENT OR OLD, SIMPLE OR COMPLICATED.

By EDMOND SOUCHON, M.D.,
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HISTORY.

One morning in 1895, upon visiting my wards in the Charity Hospital, I found an old man with a case of irreducible dislocation of the shoulder of three months' standing. He suffered much pain, and was anxious for relief. I remembered having seen, during the many years of my connection with this hospital, some eight or ten cases of such irreducible dislocations. Two, who had been put through the extension and manipulation processes, had suffered fracture of the bone near the head. None of those who had resisted tractions and manipulations of all sorts had been operated; all had been turned away to remain crippled for the remainder of their days. And yet they were under the care of such men as Stone, Richardson, Smyth, Logan, Chopin, Schuppert, all men of recognized judgment and unsurpassed daring. Later, upon writing to a member of this Association, who once graced the presidential chair, for information on the subject, he answered that very few surgeons operated on these cases, and they were left to be maimed for life.

To show the unsettled condition of mind of some prominent surgeons, I will state that, in a private communication from one of them attached to one of the largest hospitals in this country, he says that the question arose as to whether operative interference should be attempted, and having called in consultation

two other prominent surgeons, it was *finally* decided to operate. My first impulse was to follow the tradition, but the patient complained so much that I determined to operate, if but to relieve the pain due to the pressure of the dislocated head upon the nerves and the vessels. Before doing anything I attempted to post myself on the operation, but text-books were almost mute on the subject; standard works even said nothing, or very little; special cases or monographs were not at hand, and too far away to be had in time. The history of the case is given further. Once engaged in this line of thought, I became intensely interested, all the more so that another case had presented itself at the hospital in the meantime, and was awaiting treatment.

Upon making bibliographical researches, I was quite amazed to see how much the subject had engaged the attention of a number of surgeons, and also how inconceivable it was that, in spite of this, so little was to be found in text-books and others on so important and captivating a subject.

The first cases are reported by Weinhold and Swanzig in 1819, and by Wattmann, 1820. After an interval of nearly twenty years comes a case by Dieffenbach, in 1839, and after another lapse of thirteen years, the case of Simon in 1852. The indefatigable Langenbeck then follows with three cases in succession, and Post with one in 1861. Almost every year after this at least one case is reported. In the sixties, three cases; in the seventies, twenty-two; in the eighties, forty-nine. As we draw near the present date, cases became more numerous; the year 1891 alone saw thirteen cases; 1893, eleven; 1895, seventeen. Special papers, or dissertations more or less important, have been written by some eight or ten surgeons. Of these the particularly important, valuable, epoch-making are those of Knapp, 1891[1], Smital, 1890[2], Delbet, 1893[3a], and McBurney, 1895[3b]; all within these late years.

In this array of cases American surgeons have contributed largely. Ollier says that the first resection for irreducible dislocation was performed by Post, of New York[4], and the second one by Warren, of Baltimore[5].

The second French Congress of Surgery put up the question

of interference in irreducible dislocations; a certain number of communications were made regarding interference in dislocations of the shoulder,[6] but they are based upon insufficient data.

DIVISIONS, FORMS, AND VARIETIES OF IRREDUCIBLE DISLOCATIONS OF THE SHOULDER.

The subject which is now engaging our attention presents, from a clinical and practical standpoint, a number of forms and varieties which must be well defined at the outset. By clinical form and variety we mean a condition characterized by some feature or features bearing upon the diagnosis, the prognosis, treatment, and result.

These various forms and varieties may be summarily stated as being: First, recent, simple or complicated, and operated by reduction or resection. Second, old and simple, forward, downward, etc., and treated by reduction or resection through an anterior incision, or an axillary, or a posterior incision; or treated by subcutaneous section (fibrous, tendinous, muscular, osseous), or by an osteoclasia. Third, forms and varieties due to causes anatomical or physiological, to causes pathological, to complications, to recurrences; last, to the sequels of the operation.

We say this once for all, as we will not mention these headings in each case, thereby relieving the reading of monotonous repetition; but the reader will kindly bear in mind all the time the order followed in describing the peculiarities.

This study rests on one hundred and fifty-four operated cases. It is rare cases that most require collective and minute investigation, since one operator has seldom the opportunity to acquire extensive personal experience, and has to fall back upon that of others. Hence we report herein the histories of the cases with all details of some interest, which details are so eagerly sought and so gratefully appreciated by operators who have a rare and difficult case to deal with.

We always append the year to the name so as to identify the

case throughout, specially when the name of the same operator has been repeated in two or more cases.

Incomplete data is a very serious obstacle to a thorough study.

IMPORTANT RULE.

It goes without saying that no operation should be attempted before all possible means of bloodless reduction have been conscientiously applied in recent as well as in old irreducible or unreduced dislocations. However, very sound judgment has to be exercised as to the degree of force to be used, lest more or less extensive tears take place in the muscles, vessels, nerves, and bones, forcing an operation at a great disadvantage.

The word irreducible is here adhered to, because it conveys the idea that all bloodless means have been attempted, but in vain, and that nothing remains to be done but to operate. Whereas the word unreduced may lead one to think that nothing at all has been done as yet.

There are fifty-seven forms and varieties of irreducible dislocations of the shoulder.

I. D, Recent, simple (all forward), 4 in number.

1. Treated by reduction (Stimson, 1890; Parmenter, 1891; Keener, 1894).
2. Treated by resection (Wyeth, 1895).

Complicated, 17 in number.

3. Complicated by having been subjected to violent efforts at reduction.

Complicated with fracture.

4. Forward dislocation, treated by reduction (Stemen, 1893, 2 cases); Porter, No. 1, 1893; McBurney, No. 1, 1894; Porter, No. 2, 1896; Berger, 1896; McBurney, No. 2, 1896; Bull, 1897).
5. Forward dislocation, treated by resection (Tripier, 1886).
6. Downward dislocation, treated by reduction (Wolfler, 1890-91).
7. Downward dislocation, treated by resection (Morton, T. G., 1884; Mauclair, 1889; Croft, 1891). Poirier and Mauclair, 1892; Clutton, 1892; Monks, 1895; McGraw, 1896).
8. Backward, treated by resection (Brinton, 1897).

I. D., Old and forward; 116 in number

9. Treated through anterior incision by reduction; 40 cases.
10. Treated through anterior incision by resection, 52 cases.
11. Treated through axillary incision by reduction; 1 case.
12. Treated through axillary incision by resection; 8 cases.
13. Treated through posterior incision by reduction; 2 cases.

14. Treated through subcutaneous sections (Swanzig); 5 cases.
15. Treated through subcutaneous osteotomy (Mears); 1 case.
16. Downward, treated through axillary incision by resection; 3 cases.
17. Downward, treated by osteoclasia, one case (Desprès).
18. Backward (in the adult), treated by resection; 2 cases.

Forms and varieties due to a useful limb, to age, number, and diseases.

19. With a useful limb.
20. Congenital; treated by reduction (all backward dislocations).
21. Congenital; treated by resection (all backward dislocations).
22. In young subjects.
23. In old subjects.
24. Double, *i. e.*, simultaneously of both shoulders.
25. Spontaneous or pathological.
26. Paralytic (myopathic); one case.

I. D. O. Forms and varieties due to complications.

27. Complicated by persistent atrophy of the muscles.
28. Complicated by fatty and sclerotic degeneration of the muscles.
29. I. D. O. In subjects rheumatic and gouty.
30. I. D. O. In subjects debilitated or affected with diseases at large or other injuries.
31. I. D. O. Which have been subjected to great efforts at reduction.
32. Complicated by arthritis, acute, of the pseudo-joint.
33. Complicated by arthritis, chronic or suppurative, of the pseudo-joint.
34. Complicated by anchylosis of the pseudo-joint.
35. Complicated by pressure symptoms of the vessels and nerves.
36. Complicated by fracture in attempting to reduce before operation.
37. Complicated by fracture in attempting to reduce during operation.
38. Complicated by injuries to the vessels and nerves in attempting to reduce before operating.
39. Complicated by injury to the vessels and nerves during the operation for resection or reduction.
40. Complicated by old fracture of the tuberosities, anatomical neck and surgical neck.
41. Complicated by old fracture of the shaft.
42. Complicated by a previous unsuccessful operation.

I. D. O. Forms and varieties due to recurrences (habitual dislocations).

43. Treated by suturing the capsule (reefing).
44. Treated by incision of the capsule and stitching.
45. Treated by excision of part of the capsule and stitching.
46. Treated by reduction and stitching the head in the glenoid cavity.
47. Treated by resection of the head.

I. D. O. Forms and varieties due to the sequels of the operation.

48. I. D. O., operated by reduction or resection and followed by long suppuration.
49. I. D. O., operated by resection or reduction, and followed by necrosis of the bone.
50. I. D. O., operated by *reduction*, and followed by *anchylosis* of the head *in the old glenoid cavity*.
51. I. D. O., operated successfully by *reduction*, and followed by recurrence and *anchylosis in the pseudo-cavity*.

52. I. D. O., operated by *resection* and followed by *anchylosis of the sectioned extremity of the humerus* in or near the *glenoid cavity*.

53. I. D. O., operated by *resection*, and followed by *dislocation of the sectioned extremity* of the humerus, under or inside of the coracoid process.

54. I. D. O., operated by *resection*, and followed by *anchylosis of the sectioned extremity* of the humerus under or inside of the coracoid process.

55. I. D. O., operated and followed by anchylosis of the pseudo-joint.

56. I. D. O., operated and followed by dry arthritis of the pseudo-joint.

57. I. D. O., operated by resection, and followed by a dangling limb.

All the last forms are most frequently mentioned in connection with dislocations forward, because they are the most common of all dislocations; the others are comparatively rare.

Guide.—Each operated case presents to study the diagnosis or kind of dislocation, its duration or time of standing, the condition of the muscles of the limb, shoulder, arm, forearm, hand; extent of each movement without or with participation of the scapula, paresis, paralysis, atrophy, weakness, electrical reaction; of the artery, as revealed by the radial pulse; of the veins, by the œdema of the hand or forearm; of the nerves, by anæsthesia or pains; the operation performed; the difficulties and complications during the operation; the complications after the operation; the results immediate, the results remote or final; the remarks and the references.

IRREDUCIBLE DISLOCATIONS, RECENT AND SIMPLE.

We will call recent all dislocations no older than a month; this is somewhat arbitrary, but adopted to fix a limit.

1. *I. D.; recent, simple, and forward, treated by arthrotomy and reduction through an interior incision*, are three in number, reported by Stimson, 1890; Parmenter, 1891; Keener, 1894. See Cases I., II., III..

The duration of the dislocation was two days (Stimson), one week (Parmenter), four hours (Keener). In Stimson's case the head was arrested by the tendon of the subscapular, which was sectioned and reduction easily effected; in Parmenter's case the tendon of the two spinous and of the subscapular muscles had to be divided, and even then the reduction is difficult. Complications following the operation were totally absent in the three cases. All report primary union. The results remote are only

fair in Parmenter's case, good in Stimson's, and very good in Keener's. Therefore, the early interference in these cases is favorable.

2. *I. D.; recent, simple and forward, treated by resection* through an anterior incision, is represented by the single case of Wyeth, 1895. It was twelve days old. Through an anterior incision, McBurney's hooks were inserted in three different places, but without avail, and the head had to be resected. Severe shock followed, and death resulted in twelve hours. As far as this single case goes, it seems to show that resection is a more severe operation.

3. *I. D.; recent, complicated by fracture, and having been subjected to violent efforts at reduction*, should not be operated until the inflammation has abated, lest we might fall into bruised and lacerated tissues, which would more easily suppurate and thus give rise to a double compound condition, the open joint and the focus of the fracture.

4. *I D.; recent, complicated by fracture below the head and forward, treated by an anterior incision with arthrotomy and reduction*, has been recorded by Stemen, 1893, two cases; Porter (C. B.) two cases, 1893 and 1896; McBurney, two cases, 1895 and 1896; Berger, 1896; Bull, 1897. (See Cases V. to XII.)

The duration was a few hours in one of Stemen's cases, nine days and one month in Porter's two cases, two weeks in McBurney's, sixteen days in Berger's, two days in Bull's. All used an anterior incision down to the bone; Stemen seized the end of the upper fragment with lion-jawed forceps; in one case, Porter drilled a hole in the bone in the head and inserted a hook. McBurney inserted a peculiar hook of his invention. Berger seized the tuberosities with strong forceps (davier Farabeuf). Bull tried McBurney's hook, but had to pry the head in place with a periosteal retractor. No difficulties nor complications were experienced by Stemen, McBurney, and Bull; but Berger states that he had to pull with great force to disengage the head and bring it in the glenoid cavity; he mentions no injuries to the tuberosities. Porter (No. 2) removed a number of fragments and stitched the head to the shaft. McBurney stitched the head

to the tuberosities and shaft with catgut. No sutures through the bones were thought necessary in the other cases to insure proper adjustment of the fragments. No complication followed the operation, and primary union took place, except perhaps in Berger's case, where it is not stated, and in Porter's No. 2, where long suppuration followed and the head had to be removed. The remote result was only fair in Berger's case, good in Stemen's and Bull's, very good in Porter's No. 1 and in McBurney's; improved only in Porter's No. 2. The conclusion is that various instruments, therefore, can be used carefully to replace the head in obstinate cases, and that suturing may give a good result.

5. *I. D.; recent, complicated by fracture below the head and forward, treated by resection*, is recorded only once by Tripier. (See Case XIII.) It was thirteen days old; there was a comminuted fracture, with pieces wedged in between the humerus and the glenoid cavity, together with a fracture of the surgical neck. A serious complication at large was an aortic insufficiency with a hypertrophied heart. The union was secondary, and the convalescence delayed and interfered with by the circulatory disturbances just mentioned. The final result was only fair.

6. *I. D.; recent, complicated by fracture of the head, with dislocation of the head in the axilla treated by reduction*, is represented by the unique case of Wolfler. (See Case XIV.) He pegged the head back and reduced it. No difficulties or complications are reported; no complications are noted as following the operation; the union was primary and the final result good. McCormac says that Helferiot also used the peg, but he gives no reference. It is noticeable that the head loose in the axilla has never been known to become necrotic (McCormac). The danger of such procedures is the consequent callus causing more or less limitation of movement, if it be large and irregular.

7. *I. D.; recent, complicated by fracture of the head, with dislocation of the head in the axilla, and treated by resection or removal*, are comparatively numerous, reported by Morton, T. G., 1884; Mauclair, 1889; Croft, 1891; Poirier and Mauclair, 1892; Clutton, 1892; Monks, 1895; and McGraw 1896. (See Cases XV. to XXII.) The duration or standing of the injury is laid

down as recent (Morton and Croft); eight days, Clutton; four hours (Monks); four weeks (Poirier and McGraw), all were operated by an axillary incision and by resection—*i. e.*, by removal of the dislocated head; all without serious difficulty. McGraw notes also a second fracture below the tuberosities. No complications followed the operation, and primary union is noted in all cases, all recovered with a final result good in Croft's, Clutton's, Poirier's and McGraw's; Monk's case died, apparently of shock. Clinical experience, therefore, is in favor of the removal of the head in such cases.

8. A case of *I. D., recent, and backward (subspinous), complicated by fracture of the head*, is reported by Briddon. (See Case XXIII). The head was resected—*i. e.*, removed, and the extremity of the fragment smoothed and brought into the socket. The wound suppurated, but the final result was satisfactory.

Remarks.—Stimson condemns open arthrotomy when a recent fracture is present[7a], also condemns primary excision of upper fragments; he says to wait until the inflammatory and reparative processes have ceased, then remove the upper fragment if it seems advisable[7]. In view of the results above recorded a more modern opinion was solicited from so high an authority. The courteous answer was as follows: "The opinion expressed on page 257 is, I still think, sound, although added experience and improved technique have diminished the risk incurred by operating under the conditions mentioned. I still think that arthrotomy through torn tissues infiltrated with blood and inflammatory exudates is hazardous, because of the chance of suppuration, and I think the special risk begins and increases after the first or second day. I do not condemn the early operation or primary excision when indicated; I have practised both and with success, but I here warn against the risks of what may be called the tardy early operation, cutting into swollen discolored tissues about severe injuries after the second day. The statement first referred to needs now to be supplemented by mention of McBurney's brilliant method of reducing the dislocated upper fragment, in which, by the way, the incision does not open the joint or pass through torn tissues."[8]

The following remarks from McBurney's valuable contribution are worthy of note:

Surgeons have been agreed that whenever fracture and dislocation of the same bone has occurred, the dislocation should first be reduced if possible.[9]

We must here again recall the important rule not to operate before trying to reduce, and the following remarks of McBurney are most timely:

When the fracture is near the head the heel process is useless and dangerous.[10]

Manipulations by pressure with the thumbs and fingers on the head are most infrequently successful.[11] They succeeded in 36 out of 80 cases.[12]

Failing to reduce, some surgeons have treated the fracture until firm union had taken place, and, using the repaired shaft for extension, rotation, or leverage, endeavored to reduce.[13] Three cases out of ten are reported as successful, but not without criticisms.[14]

Riberi practised passive movements to establish a false joint at the point of fracture.[15] It may succeed where the fracture is high up and the lower fragment has been raised by muscular contraction outside the upper one and near to the glenoid cavity.[16] Seven cases are reported as successful, but there are no details as regards movements, pain, or disability caused by the dislocated head.[17]

Reduction by open arthrotomy and subsequent treatment of the fracture is preferable to resection of the fractured head, because it offers the prospect of a more nearly perfect final result than the other plan.[18]

In case of reduction the bones should be sutured.[19]

If union fails resection should be made at once.[20]

If reasons exist for not performing the operation of open arthrotomy and reduction, the resection of the head might well be left for subsequent consideration, and then, after all acute symptoms had subsided, be resorted to in case sufficient pain or disability existed to call for this secondary operation.[21]

It has occurred to me that the hooks might be useful in some

cases of old dislocation of the humerus in applying counterextension to the scapula—*i. e.*, by applying also a hook at the base of the spine of the scapula.[22]

HISTORIES OF CASES OF IRREDUCIBLE DISLOCATIONS OF THE SHOULDER, RECENT AND SIMPLE.

CASE I. *1890, Stimson* (*Lewis A.*).[23] I. D., recent, simple forward (left intra-coracoid), anterior incision, arthrotomy, reduction; result good.

Man, aged 53 years. *Diagnosis:* Forward intracoracoid. *Duration:* One day. *Movements*, etc.: Arm powerless and much swollen. *Operation:* Anterior incision exposing the joint. *Difficulties*, etc.: The head of the humerus lay well to the inner side, and its neck was crossed in its outer side and above by the untorn tendon of the subscapular muscle; after division of this muscle the head was easily returned to its place. *Complications after operation:* None. *Result immediate:* Wound healed primarily. *Result remote:* Nine months after abduction was retarded more on the left than on the right side; rotation almost complete; backward and forward movements about half; patient at work running an elevator. *Remarks:* There was also at the same time a dislocation of the right shoulder, but it was reduced without operation.

CASE II. *1891. Parmenter* (*John*).[24] Recent, simple forward (intracoracoid), anterior incision, arthrotomy, reduction; result fair.

Man, aged 50 years. *Diagnosis:* Intracoracoid. *Duration:* One week. *Movements*, etc.: Great deviation of the arm from the normal; unusual fixity in that position. *Operation:* Incision four or five inches long through the anterior border of the deltoid; capsule reached, opening of the joint. *Difficulties and complications:* Neck tightly grasped by the capsule, the supra- and infraspinous muscles; subscapular very tense; long tendon of biceps lay tensely stretched across the greater tuberosity, it having been thrown out of its groove; hole in the capsule enlarged, and an attempt made at reduction; not until the subscapular and the spinous muscles were divided at their insertions, was reduction possible, and then only with difficulty. *Complications after the operation:* Fever, redness, etc., but no pus. *Result immediate:* Primary union; at the end of three weeks passive motion was begun. *Result remote:* He gradually came to using his arm freely in all directions, except raising it to a right angle, owing to the paralysis of the

deltoid. Six months later, no improvement in the deltoid movements; very little grating in the joint; atrophy of the deltoid comparatively little. *Remarks:* None.

Case III. *1894. Keener (W.).*[25] Recent, simple forward (intracoracoid), anterior incision, arthrotomy, reduction, result good.

Man, aged 22 years. *Diagnosis:* Intracoracoid dislocation. *Duration:* Recent, reduction attempted immediately after accident, after which, failing, operation was performed. *Movements*, etc.: ? *Operation:* An incision was made over the pectoralis major, which, being drawn downward, revealed the head of the bone deep between the pectoralis major and minor. The capsule was not ruptured, but seemed to be pushed before the head of the bone, while, closely hugging the anatomical neck, both anteriorly and posteriorly, were large, firm, cord-like bundles of fibres reinforcing the ligament proper. The anterior was the heavier of the two. Both the humeral and scapular attachments were divided with a scalpel, and the bone went easily into place. Wound closed and sealed with collodion. *Difficulties and complications of operation:* None. *Complications after the operation:* ? *Result immediate:* No fever, primary union. *Result remote:* The limb finally as good as before. *Remarks:* Patient says the shoulder had been once before dislocated when a mere child.

Case IV. *1895. Wyeth (J. A.).*[26] Recent, simple, forward (subcoracoid), anterior incision, resection, death.

Man, aged ——. *Diagnosis:* Subcoracoid dislocation. *Duration:* 12 days. *Movements*, etc.: ? *Operation:* Incision; the upper fragment of the humerus is exposed; drilled three different holes in it to insert McBurney's hooks. *Difficulties and complications of operation:* No amount of force in any direction could reduce the dislocation; finally, had to resect the head and put the arm in ordinary splints. *Complications after the operation:* Severe shock. *Result immediate:* Patient died in twelve hours. *Remarks:* ?

HISTORIES OF CASES OF IRREDUCIBLE DISLOCATIONS, RECENT AND COMPLICATED.

Case V. *1894. Stemen, (C. B.).*[27] Case V. I. D., recent, complicated, and forward, with fracture of the surgical neck; incision to the bone, reduction, result good.

Man, aged 30 years. *Diagnosis:* Forward dislocation, with fracture about three inches below the joint. *Duration:* A few hours. *Move-*

ments, etc.; Nothing special. *Operation:* Cut down through the soft parts and then grasped the end of the bone with a strong lion-jawed forceps; reduction with but little difficulty. Fracture reduced and treated as a compound fracture. *Difficulties and complications of operation*: None. *Complications after the operation:* None. *Result immediate:* Primary union. *Result remote:* Good. *Remarks:* It is the first time that such procedure was done.

CASE VI. *1893. Stemen (C. B.).*[28] Similar case and good results.

CASE VII. *1893. Porter (Charles B.).*[29] No. 1. I. D., recent, complicated, forward (subcoracoid) with fracture of surgical neck; V incision, insertion of hook, reduction, result very good.

Man, aged 54 years. *Diagnosis:* Subcoracoid dislocation, with fracture of the surgical neck; *i. e.*, axillary, subspinous. *Duration:* Nine days. *Movements*, etc.: ? *Operation:* On *November 18, 1893*, V-shaped incision over shoulder through deltoid into the joint. *Difficulties and complications of the operation:* Found comminuted fracture of the surgical neck; removed two fragments of bone the size of a quarter, and removed smaller fragments. Drilled a hole in head of the bone, and inserting a strong hook into the hole, pulled the head back into the glenoid cavity; when the head got to the edge of the glenoid cavity it slipped into it easily and in good position. *Complications after the operation:* Stains through the plaster; a window in the plaster; redness, suppuration. *Result immediate:* Was discharged relieved on the fifty-second day. *Result remote:* Six months later very good motion; says arm is just as good as before the injury. There is some atrophy of the deltoid.

CASE VIII. *1894. McBurney (Charles).*[30] Recent, complicated forward, with fracture; anterior incision, reduction, result good.

Man, aged 45 years. *Diagnosis:* Subcoracoid dislocation, with fracture below the head. *Duration:* Two weeks. *Movements*, etc: None possible. *Operation July, 1893:* Incision about one and a half inches long, beginning about one inch below the acromion, through the deltoid muscle to the outer surface of the upper fragment; hole drilled completely through the very obliquely bevelled bone; insertion of a special hook as far as it would go; forearm and upper arm then slowly carried outward and nearly to a right angle with the body; with the powerful hook in the right hand and fingers of the left hand on the head of the humerus, vigorous traction is made in the same direction; effort required, very considerable, but no change of direction needed; reduction accomplished at first attempt; apposition of the fragments

then was so very perfect that suturing of bones not deemed necessary; two deep catgut sutures were passed through the soft parts immediately overlying the bone. Arm brought close to the chest without displacing fragments; wound closed with catgut, with drainage; sterile dressing, plaster-of-Paris bandage. *Difficulties and complications of operation:* None. *Result immediate:* Primary union; after a week in bed patient was able to walk about, using a sling to support the heavy bandage. On twenty-fourth day, firm union; moderate passive movements of the shoulders. *Result remote:* From fifth week, passive movements and massage daily; on seventh week patient able to return home without apparatus of any kind; voluntary movements of shoulder-joint satisfactory. Four months after operation voluntary and passive movements as good as those of the other side, no atrophy of muscle, no deformity at point of fracture; patient claims that the use of arm is as good as before injury. *Remarks:* None.

CASE IX. *1896. Porter* (*Charles B.*) No. 2.[31] Recent, complicated, forward, with refracture of surgical neck; anterior incision, reduction, stitching of head to the shaft, later resection, result improved.

Woman, aged 50 years. *Diagnosis:* Subcoracoid dislocation with fracture of head of humerus, swelling and ecchymosis. *Duration:* One month. *Movements*, etc.: No paralysis. *Operation:* Attempt to reduce by Kocher's method, etc., but of no avail; forcible rotation of the arm produced refracture of the partially united fracture, probably of the surgical neck. Next day incision six inches long on top of the shoulder, running down four inches below top of acromion, carried through deltoid to the bone. *Difficulties and complications of the operation:* Oblique fracture of the surgical neck running up through the tuberosities, which were comminuted. Head of bone not to be seen; searched for it, found it driven in beneath the coracoid process and tightly wedged there; attempt to dislodge it with hooks and forceps unsuccessful, though much force is used; surrounding tissues separated and further attempts made, but the head remained fixed. Biceps tendon found to be holding head down, so it is cut; head then drawn into its normal position with much force, when sudden very profuse hemorrhage from the wound; blood dark-colored; wound at once tightly packed with gauze and sponges; hemorrhage stopped. Removal of comminuted pieces of bone; head stitched to the shaft by silver wire. *Complications after the operation:* Suppuration. *Result immediate:* Long suppuration, head resected—*i. e.*, re-

moved. *Result remote:* One year after, still fistulous tracts; patient is able to reach his head with the hand.

Case X. *1896. Berger (P.).*[32] I. D.; recent, complicated forward, with fracture; anterior incision, arthrotomy, reduction with forceps, result poor.

Sex?; age? *Diagnosis:* Intracoracoid luxation. *Duration:* Sixteen days. *Movements*, etc.:? *Operation:* Deltoid incised along the anterior edge of the glenoid cavity; capsule freely incised; after dislocation was reduced the capsule was stitched up, and also deltoid and skin. *Difficulties and complications of the operation:* Glenoid cavity was free, but the articular capsule was tensely stretched between the head of the humerus and glenoid cavity; reduction of the head very hard, because the head had penetrated so far under the pectoralis major. The head had to be seized by the tuberosities with forceps, "davier Farabeuf," and pulled with great force in order to disengage it and bring it into the glenoid cavity; there was a fracture of the upper end of the humerus, but the fragments were in apposition, and it was not necessary to unite them by an osseous suture. *Complications after the operation:*? *Result immediate:*? *Result remote:* improved; three months after the operation the patient could bring his hand to his face and carry the elbow to the height of the shoulder; these movements were partly due to the mobility established between the shoulder-blade and body. *Remarks:* Ten days after the accident attempt at reposition under chloroform failed.

Case XI. *1896. McBurney (Charles).*[33] I. D.; recent, forward (subcoracoid) with recent refracture through the anatomical neck; anterior incision, reduction, suture of bones, result very good.

Man, aged 28 years. *Diagnosis:* In attempting to reduce by Kocher's method, before the outward rotation of the humerus had been half complete, marked crepitus was felt, and the effort at reduction stopped; partial union between the fragments had occurred. *Duration:* One month. *Movements*, etc.: Great pain and disability. *Operation:* Straight incision from top of acromion downward for three and a half inches through the anterior portion of the deltoid muscle to the bone throughout. Separation of the soft parts with retractors revealed the line of fracture; it was accurately through the anatomical neck. By rotation of the humerus the fracture could be readily and widely opened, and the evidence of former partial union was clear. Head of the bone lay deeply imbedded in the coracoid position; a slight extension of the incision upward and inward allowed the outer

portion of the head to be seen. The drill was applied at a point a quarter of an inch from the edge of the fracture, so passing first through the articular surface. The hook was then inserted and, while the humerus was held away from the body, traction was made on the head outward and forward. *Difficulties and complications of the operation:* Feared to apply great force lest the cancellous tissue of the head should give way, and at the first attempt only succeeded in lifting the head a short distance. The second attempt resulted in a similar manner. At the third effort I used more power and would feel the head of the bone rise more than an inch from its abnormal position. At the same time one of my assistants pushed vigorously with the fingers on the head of the bone and toward the glenoid cavity, and reduction was effected with entire success. The fragments were now sutured together with catgut, the fractured surfaces meeting very accurately. The wound in the soft parts and into the skin was closed with catgut, and a drainage-tube inserted at the upper and lower end of the wound. *Complications after the operation:* None. *Result immediate:* Primary union. *Result remote:* Slight passive movements were begun at the beginning of the fifth week, and continued and increased almost daily for seven weeks from the day of the operation. At that time motion at the point was perfectly smooth in character; the hand could grasp completely the shoulder of the sound side, the forearm could be actively passed behind the back until the upper arm touched the thorax. The hand could be actively passed behind the head and the arm elevated to a right angle with the body. *Remarks:* ?

Case XII. *1897. Bull (W. T.).*[34] I. D; recent, forward, complicated by fracture of the head, anterior incision, arthrotomy, reduction, result good.

Boy, aged 15 years. *Diagnosis:* Subcoracoid or axillary; the head was fully in the axilla; the arm from acromion to epicondyle is shorter by three-quarters of an inch than the other; soft crepitus on rotation; head could be felt immovable in the axilla. *Duration:* Forty-eight hours. *Movements*, etc.: Shoulder much swollen; deltoid rigid. *Operation:* Longitudinal incision through the fibres of the deltoid just internal to the acromion, exposing the seat of fracture and capsule of the joint; the upper epiphysis, consisting of head and tuberosities, was separated from the shaft, but held in close contact by periosteum and fascia; head fully in the axilla, no displacement relative to the shaft; division of the capsule; head was pried into place with a periosteal retractor; anterior or outer part of wound closed over an iodo-

form tampon, which rested on head of the humerus; a second one was placed in a counter-opening posteriorly, also leading to within the capsule. *Difficulties and complications of the operation:* None. *Complications after the operation:* None. *Result immediate:* Moderate wound reaction. *Result remote:* In two and a half months all wounds were healed; at the end of eight months has, for practical purposes, good use of the hand and arm, no shortening, no atrophy, though just below the acromion the fulness of the deltoid is less marked than on the other side, moderate stiffness, head of bone clearly in place, rotation possible to about one-half its normal extent, abduction about three-quarters of the way to the right angle (horizontal position); movement of the scapula complete, and the range of motion but a trifle short of that possible on the sound side. *Remarks:* None.

Case XIII. *1886. Tripier.*[35] I. D.; recent, forward, complicated by fracture of head and surgical neck, anterior incision, resection, result fair.

Sex, male; age, 49 years. *Diagnosis:* Subcoracoid luxation, with fracture of head of humerus. *Duration:* Thirteen days. *Movements*, etc.: Loss of power in arm, sharp pain around upper end of arm. *Operation:* An incision ten centimetres long running from coracoid apophysis downward in direction of the insertion of deltoid with pectoralis major; cephalic vein turned inward, capsule previously not torn, opened; head cannot be replaced and is extirpated; counter openings, drainage, antiseptic dressing. *Difficulties and complications of the operation:* These depended mostly upon a number of small fragments of bone which were caught between the head and the glenoid cavity, and could not be removed until the head was resected; they completely hindered any reduction of the head; the capsule was found filled with blood when opened; the greater tuberosity had been broken off, and the fragments of the bone found were portions of the glenoid cavity; there was a fracture of the surgical neck. *Complications after the operation:* None dependent on the operation. *Result immediate:* Secondary union, convalescence delayed and interfered with by circulatory disturbances. *Result remote:* Three months after operation movements of arm good, adduction somewhat limited; the movements forward and backward are good; in abduction, patient can put his hand on the healthy shoulder; arm hangs normally, but is a little separated at the elbow from body; raises his hand easily to mouth; movements of circumduction like the rest, fair; rotation very limited. *Remarks:* Shoulder was very much swollen, and there was a large

ecchymosis extending almost to elbow; attempt at reduction was made two days before the operation, but was unsuccessful. Patient had aortic insufficiency and a hypertrophied heart.

Case XIV. *1890–91. Wolfler.*[36] I. D.; recent, complicated, downward (in axilla) of fractured head through anatomical neck; axillary incision; "pegging" of the fragments, reduction, result good.

Man, aged ——. *Diagnosis*: Fracture of the head through anatomical neck, head loose in axilla. *Duration:* Recent. *Movements*, etc.: ? *Operation:* Axillary incision "pegging" of the head, reduction. *Result immediate:* Primary union. *Result remote:* Fair. *Remarks:* ?

Case XV. *1884. Morton (Thomas G.).*[37] I. D.; recent, complicated, downward (in axilla) with fracture through anatomical neck; axillary incision; resection; death.

Male, aged 73 years. *Diagnosis:* Fracture through anatomical neck of the humerus, with complete separation and dislocation of the head of the bone into the axilla. *Duration:* ? *Movements*, etc.: Preternatural mobility of the joint, but crepitation not marked. *Operation:* After a number of vigorous efforts at reduction without success, the head of the bone in the axilla was removed by a small incision at the lowest part of the axillary region. The wound was brought together by silver sutures, and the arm bound to the chest. *Complications after operation:* The patient was in a condition to leave the hospital thirteen days after the operation, but on the fourteenth day he was taken with severe diarrhœa, with great exhaustion, which terminated fatally a week later. *Result:* Death. *Remarks:* The humerus showed considerable absorption and rounding off at seat of fracture.

Case XVI. *1889. Mauclair.*[38] I. D.; recent, complicated, downward (in axilla of fractured head through anatomical neck), axillary incision, resection—*i. e.*, removal of head, result not stated.

Man, aged 63 years *Diagnosis:* Head felt in axilla. *Duration:* Twenty-four days. *Movements*, etc.: Deltoid atrophied; tickling in the fingers. *Operation:* Axillary incision. *Difficulties and complications of operation:* Head deeply seated, adhering to the inner surface of the shaft; impossible to reduce head; head detached by the fingers from the shaft; head seized with bone forceps and removed easily; upper extremity of humerus kept well opposite the glenoid cavity. *Complications after operation:* ? *Result immediate:* ? *Result remote:* ?

Case XVII. *1889. Wattson's* case, reported by McLaren.[39] I. D.;

recent, forward (subcoracoid), anterior incision, fracture of greater tuberosity, reduction with a scoop, result good.

Man, aged 40 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Four weeks. *Movements*, etc.: ? *Operation:* Incision of about eight inches long was made over the interval between the deltoid and clavicular portion of the pectoralis major; capsule found torn completely away; finger encountered first the glenoid cavity and then a rough surface on the head of the humerus. This proved the spot from which a piece of bone, comprising the two upper parts of the greater tuberosity, had been broken off; a fragment was found attached to the under surface of the tendons, which are inserted into it, and was lying at a little distance from, not in, the glenoid cavity; biceps tendon was in position, head of humerus lay under the coracoid process. *Difficulties and complications of the operation:* Dr. Watson inserted a narrow lithotomy scoop into the wound, and passing it to the inner side of and beneath the head, succeeded in levering it up into the glenoid cavity; a drainage-tube was inserted, wound stitched and dressed. *Complications after the operation:* About a week after the operation patient's mind began to wander, and he became subject to delusions, etc., but under proper treatment this symptom gradually passed away. *Result immediate:* Wound healed in a week's time. *Result remote:* Eight weeks after operation passive motion was begun. Eight months after the operation, patient can touch top of his head, opposite shoulder, back of hip on same side. He can abduct the arm from the side 70°, but has very little power of external rotation. It is interesting to note that supination is impaired. *Remarks:* Patient had gone to bed about twelve o'clock, feeling well (before the operation), and two hours later woke up with pain in shoulder, and unable to move his arm; no accident or cause known for the dislocation.

Case XVIII. *1891. Croft.*[40] I. D.; recent, downward (in axilla), with fracture through anatomical neck; axillary incision, resection, result good.

Man, aged 33 years. *Diagnosis:* Axillary dislocation of head of humerus, which was fractured through the anatomical neck; a hard semi-globular mass was felt lying in the axilla; extensive ecchymosis. *Duration:* Three days. *Movements*, etc.: Has hardly any power in forearm and fingers, all movements are affected. *Operation:* Incision along the anterior fold of the axilla; dissecting through the tissues infiltrated with blood; the head of the bone was found lying loose just

below the glenoid cavity; the nerve-cords and the axillary vessels were roughly separated from the tissues; the fracture was almost through the anatomical neck; the jagged upper end of the shaft was trimmed with bone forceps. *Difficulties and complications of the operation:* ? *Complications after the operation:* ? *Results immediate:* Primary union. *Result remote:* improved.

Case XIX. *1892. Poirier and Mauclair.*[41] I. D.; recent, complicated, downward (in axilla, of fractured head through anatomical neck), axillary incision, resection—*i. e.*, removal of head, result very good.

Sex ?; aged 37 years. *Diagnosis:* Head easily felt in axilla. *Duration:* Recent. *Movements*, etc.: ? *Operation:* Axillary incision, removal of head, extremity of the humerus kept well opposite the glenoid cavity. *Difficulties and complications of the operation:* None. *Complications after operation:* None. *Result immediate:* Primary union. *Result remote:* Three months after accident, patient can move his arm to the horizontal; almost forward and backward; does movements of circumduction pretty extensive, all active movements; he can raise his hat with his hand.

Case XX. *1892. Clutton* (*N. H.*).[42] I. D.; recent, complicated, downward (in axilla) with fracture of head; axillary incision; resection; result good.

Female, aged 61 years. *Diagnosis*: Dislocation of head of humerus with fracture of the anatomical neck. *Duration:* Eight days. *Movements*, etc.: Could not move the arm herself; the shaft of the humerus could be moved in all directions without moving scapula. *Operation:* Incision was made into the axilla, and the head of the humerus was exposed. *Difficulties and complications of operation:* Head fractured through anatomical neck; it is lifted out of the wound without use of knife or scissors; the finger was introduced and passed readily through a large opening into the joint; the capsule on the distal side felt rough and bony; greater tuberosity torn off from the shaft; finger was easily swept around the upper end of the bone, except at the lesser tuberosity. *Result immediate:* Wound healed by first intention; no passive movements employed, but the patient was encouraged to use her shoulder as much as possible in various ways. *Result remote:* Eight months after operation she can put her hand to the back of her head, to her mouth, and to the top of the opposite shoulder, also behind the back; shoulder rather fixed in raising the arm from side. *Remarks:* The specimen, now in St. Thomas' Hospital

Museum, comprises the entire head of the humerus, the line of fracture following the margin of the articular surface for two-thirds of the circumference of the bone, whilst the remaining third has encroached upon the tuberosities to the extent of three-quarters of an inch from the articular margin.

CASE XXI. *1895. Monks (G. H.).*[43] I. D.; recent, complicated, downward (in axilla), with fracture of the head; axillary incision, removal of head; death.

Man, aged ? years. *Diagnosis:* Dislocation of the shaft below the tuberosities; the detached head became displaced and wandered into axilla, where it could be felt easily when the man entered the hospital; the fractured surface rested against the thorax. *Duration:* A few hours. *Movements*, etc.: ? *Operation:* It was obviously impossible to put back the bone by manipulation; incision made into the axilla down to the ruptured fragments. *Difficulties and complications of the operation:* The head was entirely free except for a tendon attached to a part of the greater tuberosity, that tendon proved to be that of the subscapular muscle, a fact which explains why the head was drawn inward into the axilla and could not be returned to the glenoid cavity; in the wound it seemed impossible to return the fragments to their proper place. *Complications after the operation:* All did well for two days, when abdominal distention appeared, as well as other serious symptoms, and the man died four days after the operation; the autopsy could not determine the cause of death. There was also a fracture of the greater tuberosity. *Result immediate:* Primary union. *Result remote:* Death. *Remarks:* None.

CASE XXII. *1896. McGraw (Th.).*[44] I. D.; recent, complicated, downward, complicated by fracture of the head; axillary incision—*i. e.*, removal of head, result good.

Man, aged 45 years. *Diagnosis:* Dislocation of head, fractured through anatomical neck; in the axilla could be plainly felt a hard, round body, which only could be the head of the humerus. *Duration*: Four weeks. *Movements*, etc.: Elbow far from the side. *Operation:* Incision through the deltoid three inches long, and joint exposed. *Difficulties and complications of operation:* Bone broken through anatomical neck, and completely detached and displaced into axilla. Also a second fracture below the tuberosities, passing diagonally through the bone from before and above, downward, outward, and backward; the upper end of the lower fragment projected on the inner side of the arm, crowding the upper fragment; endeavored to reach the de-

tached head, but combined muscular tension and inflammatory deposits made it impossible without extensive dissection and detachment of muscle; the supra and infraspinous and subscapular held the upper fragment firmly against the acromion; lower fragment was pulled as firmly against the upper. Axillary incision, opening of the capsule, removal of head; although completely detached, it is firmly held between the capsule and the neighboring bone; there is considerable difficulty in removing it. *Complications after operation:* None. *Result immediate:* Primary union. *Result remote:* Thirteen months after he has perfect use of arm, could lift it nearly at right angles with the body, suffers no inconvenience from arm whatever. *Remarks:* None.

Case XXIII. *1897. Brinton (J. H.).*[45] I. D.; recent, backward (subspinous) complicated by fracture of head of humerus, acromio-humeral incision; resection of head, improved.

A girl, aged ? *Diagnosis:* X-rays showed subspinous dislocation of head with transverse fracture of humerus below the tuberosities. *Movements*, etc.: ? *Duration:* Three days. *Operation:* Acromio-humeral incision through deltoid to the bone; head removed above the line of fracture, which was practically at the epiphyseal junction; upper end of lower fragment smoothed off; deltoid incision sewed up with kangaroo tendon by continuous suture; drain; skin is sutured by silkworm gut. *Difficulties and complications of the operation:* ? *Complications after the operation:* ? *Result immediate:* Suppuration; gradually healed. *Result remote:* Two months later, patient is discharged; motions of false joint returning satisfactorily. *Remarks:* ?

TABLE OF DIFFICULTIES, COMPLICATIONS, AND RESULTS OF IRREDUCIBLE DISLOCATIONS, OLD, SIMPLE, AND FORWARD, OPERATED THROUGH AN ANTERIOR INCISION.

I. D. O. Forward, treated through an anterior incision by arthrotomy and reduction.	*I. D. O. Forward, treated through an anterior incision by arthrectomy or resection.*
Difficulties and Complications of the Operation.	*Difficulties and Complications of the Operation.*
1. *Capsule thick*, 10 per cent.: Garmany, 1888. Schede No 2, 1892. Poncet, 1893. Souchon, 1895.	
2. *Dissection tedious*, 8 per cent.: Severeano, 1892. Pollosson, No. 5, 1893. Ransohoff, 1897.	2. 2 per cent.: Weinlechner, 1876.
3. *Reduction difficult*, 24 per cent.: Wattman, 1820, used a lever. Lister, 1873, Nos. 1 and 2, used pulleys in both cases. Albert, 1874, used two steel hooks. Schonborn, No. 1, 1885. Watson, 1889, used a lithotomy scoop as a lever. Gould, 1891, used pulleys and a raspatory as a lever. Cheyne, 1891. Cotterill, No. 1, 1892. Cotterill, No. 2, 1893.	3. 12 per cent.: Langenbeck, 1862. Reid, 1880. Thornburn, 1891, head difficult to remove. Gwyer, 1891, head difficult to remove. Delbet, 1893, head difficult to remove, gouged and sawed through anatomical neck. Porter, 1894, head hard to remove.
4. *Excessive fibrous tissue* around head and surgical neck, 13 per cent.: Burckhardt, 1878. Bruns, 1877, very extensive. Wolfler, 1890. Cheyne, 1891. McCormac, 1893.	4. 28 per cent.: Paget, 1868. Thiersch, 1874. Annandale, 1875. Hofmokl, 1881. Ollier, 1886. Sheild, 1888. Kocher, No. 8, 1889, adhesions also on cartilage of head. Gwyer, 1891. Delbet, 1893. Lizars, No 2, 1895. Bickham and Souchon, 1895. Boone, 1896. Chénieux, 1896. Erdmann, 1896.
5. *Head deeply seated.*	5. No per cent.: Sheild, 1888. Gwyer, 1891, head resting on ribs. Porter, 1894.
6. *Head adherent to ribs.*	6. 2 per cent.: Annandale, 1875, removed piecemeal.
7. *Extensive muscular incisions*, 16 per cent.: Wattman, 1820. Lister, No. 2, 1873. Gould, 1891. Schede, No. 1, 1892. Cotterill, No. 1, 1893. Cheyne, 1893.	
8. *Old fracture of great or small tuberosity* not united to the bone, 10 per cent.: Burckhardt, 1878, great tuberosity removed. Pfeiffer, 1886, not removed. Blasius, 1886, small tuberosity removed. Watson, 1889.	
9. *Old fracture of great or small tuberosity united to bone*, 8 per cent.: Gurlt, 1886, great tuberosity removed. Bruns, 1887, removed. McCormac, 1893.	9. 24 per cent.: Langenbeck, 1858, great tuberosity. Langenbeck, 1862, small tuberosity. Reid, 1872, great tuberosity. Pfeiffer, 1886, great tuberosity. Finckh, 1889. Kocher, No. 2, 1889, great tuberosity. Kocher, No. 4. 1889. Kocher, No. 5, 1889. Kocher, No. 6, 1889. Kocher, No. 8, 1889, great tuberosity. Robson, 1890, great tuberosity. Thornburn, 1891.
10. *Old fracture of anterior part of the glenoid cavity* united or not to the bone, 8 per cent.: Wattman, 1820. Cotterill, No. 2, 1893. McCormac, 1893.	10. 2 per cent.: Kocher, No. 3, 1889.
11. *Old fracture of humerus united*, 3 per cent.: Bruns, 1887, surgical neck.	11. 8 per cent.: Kocher, No 2, 1889, anatomical neck. Kocher, No. 5, 1889, anatomical neck; the fracture was refractured during attempt to reduce Erdmann, 1896, same. Veer, 1897, same.
12. *Glenoid cavity normal*, 10 per cent.: Severeano, 1893. Poncet, 1893. Souchon, 1895. Ransohoff, 1897, in part.	12. 2 per cent.: Finckh, 1889.

13. *Glenoid cavity filled with capsule and fibrous tissue*, 32 per cent.: Wattman, 1820. Pfeiffer, 1886. Maas, 1886. Kocher, No. 7, 1889. Vamossy, 1890. Wolfler, 1890. Schede, No. 1, 1893. Schede, No. 2, 1892 Cotterill, No. 1, 1893. Cotterill, No. 2, 1893. McCormac, 1893, in part. Ransohoff, 1897, in part.

14. *Glenoid cavity free*, 26 per cent.: Burckhardt, 1878. Pfeiffer, 1886. Maas, 1886. Bruns, 1887, the cartilage was intact. Garmany, 1888. Vamossy, 1890. Wolfler, 1890. Schede, No. 1, 1892. Cheyne, 1893. McCormac, 1893.

15. *Parenchymatous hemorrhage during operation*, 3 per cent.: Pollosson, No. 5, 1893, possible injury to axillary vein.

16. *Wounds of vessels during operation*, no per cent.

17. *Rupture of artery in trying to reduce before or after cutting*, no per cent.

18. *Fracture of humerus in trying to reduce before or after cutting*, 9 per cent.: Albert, 1874, surgical neck before cutting, fragments sutured.

19. *Sundries*, 13 per cent.: Vamossy, 1890, great tuberosity had to be cut off in order to unite the wound. Wolfler, 1890, head of humerus partly destroyed. Schede, No. 1, 1892, crepitation in joint. Cotterill, No. 1, 1893, deltoid adherent to humerus. Pollosson, No. 5, 1895, attempt at reduction two weeks before operation, with large ecchymosis.

Complications After the Operation.

1. *Hemorrhage*, 3 per cent.: Burckhardt, 1873, blood soaked through the bandages.

2. *Gangrene of limb*, no per cent

3. *Suppuration* (see results remote).

4. *Necrosis of head*, 16 per cent. Socin, 1885. Bruns, No. 1 and No. 2, 1887, removal of necrotic pieces of head, resection of necrosed head. Wolfler, No. 1, 1890, resection of head; removal of necrotic pieces from the glenoid cavity. Pollosson, No. 4, 1893, resection of head. McCormac, 1893, resection of head through anatomical neck. Souchon, 1895, shedding of cartilages.

13. 14 per cent.: Fenger, 1889. Kocher, No. 3, 1889. Robson, 1890. Wolfler, No. 2, 1891. McCormac, 1893. Bremken, 1896. Chénieux, 1896.

14. 2 per cent.: Lejars, No. 2, 1895.

15. 4 per cent.: Hofmokl, 1881. Veer, 1897 amputation at shoulder.

16. 2 per cent.: Annandale, 1875, circumflex and axillary arteries, ligation.

18. 8 per cent.: Thiersch, 1874, after cutting. Kocher, Nos. 4 and 5, 1889, before cutting. Erdmann, 1896, before cutting. Veer, 1897, same.

19. 26 per cent.: Lister, No. 2, 1873, head removed piecemeal without interfering with the tuberosities. Annandale, 1875, removal of head piecemeal. Reid, 1880, it was a double dislocation and double resection. Ollier, 1888, difficulty keeping resected end in glenoid cavity. Fenger, 1889, coracoid process broken to make room for reduction. Fenger, 1889, head of humerus diseased. Bardeleben, 1889, suppuration of pseudo-joint. Kocher, No. 2, 1889, rupture of muscles due to recent attempt at reduction. Kocher, No. 5, there was a double fracture of the head which had been refractured in trying to reduce. Kocher, No. 6, 1889, deltoid had become very stiff and tense. Kocher, No. 8, 1889, adhesions over cartilaginous surface of head. Lejars, No. 1, 1875, the head had to be removed through posterior axillary incision, because the nerves and vessels were in front of the head. Lejars, No. 2, 1895, the small pectoral muscle was sclerosed and circled the head like a bridle.

Complications After the Operation.

1. 6 per cent.: Ismel, 1876, abundant, death. Hofmokl, 1881, bandage had to be removed every day for ten days. Bickham and Souchon, 1895, patient had to be transfused.

2. 2 per cent: Annandale, 1875, from ligation of axillary artery.

3. See results remote.

4. 2 per cent.: Reid, 1880, necrosis of resected extremity.

5. *Formation of a pseudarthrose* at the point of fracture, 3 per cent.: Albert, 1874.

6. *Sundries*, 3 per cent: Delirium tremens and bronchitis purulent. Schonborn, No. 1, 1885.

Results Immediate.

1. *Death*, 13 per cent.: Schonborn, No. 1, 1885, bronchitis purulent. Maas, 1886, sepsis. Schonborn, No. 2, 1892, apoplexy. Pollosson, No. 5, 1893, sepsis third week. Souchon, 1895, miliary tuberculosis in peritoneum.

2. *Primary union*, 26 per cent.: Albert, 1878. Garmany, 1888. Watson, 1889. Vamossy, 1890. Gould, 1891. Cheyne, 1891. Schonborn, No. 1, 1892. Severeano, 1893. Cheyne, 1893. Ransohoff, 1897.

3. *Short suppuration*, 17 per cent.: Lister, No. 1, 1873. Burckhardt, 1878. Pfeiffer, 1886. Gurlt, 1886. Blasius 1886. Bruns, 1887. Poncet, 1893. Porter, 1894

4. *Long suppuration*, 10 per cent.: Wattman, 1820. Maas, 1886, with dissection of the tissues and sepsis. Cotterill, No. 1, 1893. McCormac, 1893. Souchon, 1895

5. *Union of fracture which occurred during reduction*, no per cent.

6. *Neuralgic pains continue*, no per cent.

7. *Sundries*, no per cent.

Result Remote or Final.

1. *Death*, 10 per cent.: Schonborn, No. 1, 1885, bronchitis purulent. Maas, 1886, sepsis. Schede, No. 2, 1892, apoplexy. Pollosson, No. 5 1893, sepsis. Souchon, 1895, tubercles in peritoneum.

2. *No improvement*, no per cent.

3. *Improved*, 5 per cent.: Wattman, 1820. Gurlt, 1886.

4. *Fair*, 16 per cent.: Schonborn, No. 2, 1885. Bruns, 1887. Wolfler, 1890. Cotterill, No. 1, 1893. Poncet, 1893. Ransohoff, 1897.

5. *Good*, 50 per cent.: Lister, No. 1 and 2, 1873. Burckhardt, 1873. Albert, 1878 Blasius, 1886. Garmany, 1888. Watson, 1889. Kocher, No. 7, 1889. Vamossy, 1890. Gould, 1891. Cheyne 1891. Cotterill, No. 2, 1893. Severeano, 1893. Pollosson, No. 1, 1893 Pollosson, Nos. 2 and 3, 1893. Cheyne, 1893. McCormac, 1893. Reboul, 1895. Tuttle, 1897.

6. *Very good*, 3 per cent.: Pollosson, No. 1, 1893.

Results Immediate.

1. 12 per cent.: Langenbeck, 1862, sepsis, death eleventh day. Annandale, 1875, third day gangrene from ligation of axillary artery. Israel, 1876, secondary hemorrhage. Kocher, No. 3, 1889, sepsis on tenth day. Lejars, No. 1, 1895, pneumonia sixth day. Veer, 1897, hemorrhage, exhaustion.

2. 30 per cent.: Reid, 1878. Hofmokl, 1881. Ollier, 1888. Finckh, 1889. Fenger, 1889. Wolfler, No. 2, 1890. Gwyer, 1891. Owen, No. 1, 1893. Delbet, 1893. Monks, 1895. Schmittle, 1895. Boone, 1896. Bremken, 1896. Chénieux, 1896. Erdmann, 1896.

3 22 per cent.: Warren, 1869. Reid, 1872. Lister, 1873. Wienlechner, 1876. Pfeiffer, 1886, Sheild, 1882. Bardeleben, 1889. Kocher, Nos. 2, 4, 5, 6 and 8, 1889. Schonborn, 1891.

4. 16 per cent.: Langenbeck, 1858. Thiersch, 1874. Reid, 1880. Kocher, Nos. 5 and 6, 1889. Hinsel, 1890. Porter, 1894. Bickham and Souchon, 1895.

5. 2 per cent.: Thiersch, 1876, on third week.

6. 2 per cent.: Marsh, 1880.

7. No per cent.

Result Remote or Final.

1. 12 per cent.: Langenbeck, 1862, sepsis. Annandale, third day gangrene from ligation of axillary artery. Israel, 1876, secondary hemorrhages. Kocher, No 3, 1889, sepsis. Lejars, No 5. pneumonia. Veer, 1897, hemorrhage.

2. 2 per cent.: Kocher, No. 4, 1889.

3. 28 per cent.: Langenbeck, 1858. Four years later Luckie observed a dislocation of the resected extremity under the acromion process. Thiersch, 1874, fracture united in third week. Weinlechner, 1876. Schonborn, 1882. Book, 1883. Billroth, 1887. Kocher, 1889. Robson, 1890. Hinsel, 1890. Owen, No. 1, 1893. Monks, 1893. Bickham and Souchon, 1895.

4. 8 per cent.: Fenger, 1889. Kocher, No. 6, 1889. McCormac, 1893. Porter, 1894.

5 42 per cent.: Warren, 1869. Reid, 1872. Lister, No. 2, 1873. Hofmokl, 1881. Pfeiffer, 1886 Sheild, 1886. Finckh, 1889. Bardeleben, 1889. Kocher, No. 2, 1889. Kocher, No. 8, 1889. Phelps (A. M.), 1890. Wolfler, No. 2, 1890. Schonborn, 1891. Gwyer, 1891. Owen, No. 2, 1893. Wyeth, 1894. Schmittle, 1895 Boone, 1896. Bremken, 1896. Chénieux, 1896. Erdmann, 1896.

6. 8 per cent.: Reid, 1880. Bellamy, 1888. Ollier, 1888. Delbet, 1893.

IRREDUCIBLE DISLOCATIONS, OLD AND SIMPLE.

9 and 10. *I. D. O.; Forward treated through an anterior incision by arthrotomy and reduction, and by arthrectomy or resection.* See cases I. to XXIX., reductions, and Cases XL. to XCI, resections.

The study of the foregoing tables shows that some twenty different difficulties and complications have been mentioned by operators in dealing with those cases: capsule thick, dissection tedious, reduction difficult, excessive fibrous tissue around the head and surgical neck, head deeply seated, head adherent to ribs, extensive muscular dissections, old fractures of the tuberosities, of the glenoid cavity, of the humerus; glenoid cavity filled with remnants of the capsule and fibrous tissue, glenoid cavity readily freed or cleared; parenchymatous hemorrhage during the operation, wounds of vessels during the operation, rupture of the axillary artery in trying to reduce before and after cutting, and various sundry difficulties.

Some of these difficulties and complications are common to both operations, or are as likely to occur in the one as in the other. They are: neo-capsule thick, dissections tedious, excessive fibrous tissue around surgical neck and head, head deeply seated, head adherent to ribs, old fractures of the tuberosities, glenoid cavity and humerus, glenoid cavity filled with remnants of capsule and fibrous tissue, parenchymatous hemorrhage during operation, wounds of vessels during operation and sundries.

We find the following more frequent in reductions; reduction difficult, excessive muscular incisions, glenoid cavity normal, glenoid cavity freed and cleared; fracture of humerus in trying to reduce before or after cutting; of the sundries we note that the greater tuberosity had to be cut away in order to be able to unite the edges of the muscular and cutaneous wounds; the head of the humerus was partially destroyed, there was crepitation in the joint.

We note as more common in the cases of resection, excessive fibrous tissue around fractures of the head or the surgical neck, hemorrhages and sundries. Although reduction difficult is

naturally more frequently mentioned in cases of reduction, 24 per cent., yet we find that in 10 per cent. of resected cases it was difficult to place the sectioned extremity of the humerus in or near the glenoid cavity. Excessive fibrous tissue is noted specially in 28 per cent. of resections against 15 per cent. of reductions. Hemorrhages have occurred oftener in resections, although there is no special reason to account for this; on the contrary, they should be more common in reductions, since these usually require more extensive dissections. Most of the sundry difficulties and complications mentioned in connection with resections are all of such nature as to have rendered resection the only operation possible.

The complications noted after the operation are: Hemorrhage, gangrene of the limb, suppuration, necrosis of head and of sectioned extremity, and the formation of a false joint in case of fracture.

Hemorrhages are more frequent in resection, 4 per cent., against none in reductions. Suppuration is twice more common after reduction. Necrosis of the head occurred in 16 per cent. of the cases of reduction against 2 per cent. of necrosis of the sectioned extremity of the humerus.

As to results immediate, primary union is noted in 26 per cent. of reductions and 30 per cent. of resections. Short suppuration occurred in 17 per cent. of reductions against 22 per cent. of resections. Long suppuration shows 10 per cent. in reduction and 16 per cent. in resection. This is all the more remarkable, that reductions necessitate more extensive dissection, and that the head and cartilage have often been reported as necrotic in reductions.

The results remote or final, show: Death 10 per cent. in reductions and 12 per cent. in resections; the causes of the fatal result are, in reductions, bronchitis, sepsis, apoplexy, and tubercles in the peritoneum. In resections, sepsis, gangrene from ligation of the axillary artery, secondary hemorrhage, and pneumonia. All these causes of death are preventable to-day except tuberculosis, apoplexy, and pneumonia, which are accidental causes. Hemorrhage can be averted by keeping close to the

bone all along in the capsulo-periosteal sheath, using a sharp chisel and hammer against the bone throughout, actually scraping the bone of its superficial compact tissue; a sharp chisel will require less force to do effective work, and is, therefore, less apt to slip and injure the vessels specially under the influence of the hammer-strokes. The dissection should proceed from backward forward. Sepsis, of course, we understand how to prevent, but it seems those cases call for extra care. The neglect to apply such systematic procedure as is recommended by Ollier to test the extent and strength of the various movements renders it difficult to judge of the true benefit of the operations, and we must be contented with the results as expressed by the operators. In a number of cases the final result is not stated. Mere improvement is not so often noted in reductions, 5 per cent., as in resections, 28 per cent. Fair results are quoted as 16 per cent. in reductions and 6 per cent in resections. Good results mark 50 per cent. in the cases of reductions against 42 per cent. in resections. Lastly, the result in good to very good is 3 per cent. of reductions and 87 per cent. of resections. If we consider only the cases noted as fair, good, and very good, we find 69 per cent. of reductions against 57 per cent. of resections, in spite of the comparatively frequent necrosis of the head in reductions. The 16 per cent. of necrosis of the head in reductions followed by resection of the head, should truly be placed to the credit of resections. Of course, the figures of percentage are most likely only approximative, because in all probability all the operated cases, good and bad, specially the latter, have not been reported.

By comparing the dates we do not see that sepsis has as yet made its full impress upon either operation. We find all the cases of necrosis of the head occurring since 1887 (Blasius), when the new era is considered to have been in operation everywhere, specially under the men of mark who stand as operators.

GENERAL AND FINAL CONCLUSIONS IN REGARD TO FORWARD DISLOCATIONS.

From the foregoing study we feel justified in formulating the following conclusions. The anterior incision is the route. Re-

duction is the more desirable operation, because it preserves the head and all the movements depending therefrom. Reduction should be done only in cases where the head and glenoid cavity are in good condition; when no extensive dissections have to be made; when it is easily effected without any great effort; when the head does not need to be trimmed, or the cup to be too deeply scooped or enlarged; when the head readily remains in place, but not too tightly. All this regardless of the time or standing of the dislocation. It should, however, always be attempted conscientiously, because many have resected, perhaps, when the dislocation could have been reduced. Disregard of these rules may result in necrosis of head, in recurrence of the dislocation or in anchylosis, with their inevitable consequences. Resections should be practised in all other cases. When in doubt it is preferable to resect. How much to resect—*i. e.*, where to saw, through the anatomical neck, or obliquely and downward outside the tuberosity, or horizontally on a level with the lower margin of the head, must be determined in each case; it is best to remove too much than too little. Of course, all efforts should be made to secure aseptic results. Extra care is called for in these cases, but specially those of reduction.

Remarks. We append here some interesting remarks on the causes of the difficulties of reductions, mostly from Delbet's paper, which was based specially on forty-four autopsies of old dislocations.

Exceptionally the fibro-cartilage of the margin of the cavity is detached, and also the periosteum, both remaining continuous with the anterior ligaments, and forming a pouch under which the head is lodged; those are called subscapulo-periosteal dislocations (Hartman and Broca). In place of the natural capsule, in some cases there is a thick fibrous mass, extending from the acromion and the deltoid to the cup and to the head of the humerus; the head has truly lost its right of domicile.[46] Sometimes the remains of the old capsule becomes partly ossified.[47] (Key. Os sesamoids dans les tendons du sus-épineux, des sous-épineux et du petit roud; Kocher, Observations II., Delbet, page 27). The capsule stretched over the glenoid may be found ad-

herent to it (cases of Bourgeois, Bordet, Burkhardt, A. Cooper, Key, Demeana, Hartman and Broca, Houel, Knapp, Kocher), one autopsy and two operations. Obs. II. and VIII; Lépine, Maas, Malgaigne (2 cases); Pfeiffer, Quenieu; in Smital (2 cases). Thore, Vamossy, Wattman.[48] In some cases the rent in the capsule has healed so completely behind the head as to prevent reduction. The capsule was ossified in a case of Kocher, No. 3. In another the glenoid cavity was filled with a thick layer of bone.[49] It is very seldom that the cartilaginous portion of the head gives insertion to fibrous bands.[50] Usually the new ligaments or adhesions or capsule extended from the margin of the new cavity to the neck of the humerus.[51] The anterior part of the neo-capsule is usually very thick, two millimetres or more, and very resistant; it is often adherent to the vessels and nerves. In one case of Lister, seven weeks old, the artery was surrounded by these fibrous bands.[52] Often a strong fibrous band, well described by Malgaigne, extends from the inferior surface of the acromion to the head of the humerus near the greater tuberosity. This is well mentioned in the cases of Bardenheuer, Faure, Fauratier, Houel (Dupuytren's Museum, 731A.), Malgaigne.[53]

The tendon of the biceps may remain in the groove and follow the humerus. It is more or less blended with the neo-capsule, and it is often difficult to dissect it. Sometimes it is adherent to the groove (Parmenter), in some cases the tendon is disinserted from the groove, glides behind the head, where it forms a tense cord in front of the glenoid cavity, (Kocher, 2 cases, observations V. and VI.; Gauderon, Knapp, Lepine, G. Smith, 2 cases, Schede).[54] In operating take care of the long tendon of the biceps. It is said that it is never displaced from its sheath in ordinary subcoracoid dislocations of the limb (F. B. Lund).[55] The tendon of the biceps should be preserved or stitched back (author).

The muscles or their sheaths, or both, often undergo sclerosis, and this prevents reduction of the head, as proved by unsuccessful reduction only after the section of the muscles (Dieffenbach, Weinhold, Bardenheuer, Ollier, Kocher, Bordet, Cooper,

Parmenter). The deltoid and the supraspinous are the muscles which mostly oppose the reduction.[56]

In some cases the anterior edge of the glenoid cavity forms a part of the new cavity, and this condition renders reduction illusionary and probably useless. This is met with once in every five.[57] Sometimes the old glenoid cavity becomes filled up by fibrous tissues.[58] The inner edge of the new cavity found on the scapula presents usually a high, rough edge.[59]

The head proper of the humerus may remain normal, but it is usually flattened behind, where it is articular. Its front part becomes covered with more or less irregular projections or stalactites.[60] With all this it may also be very large, rendering reduction impossible. The small tuberosity is sometimes torn away by the subscapular.[61] The greater tuberosity, when torn away and loose from the muscle, drops into the old glenoid cavity. When it still remains attached to the muscle it becomes united, but in an irregular manner, causing deformity and considerable widening of the region.[62] In some cases the tuberosities are very much enlarged, without any trace of fracture.[63] All those anatomo-pathological changes occur sometimes rapidly. The adhesion of the capsule to the cup has been found after two or three months; the head flattened after one month, even twenty-three days; the muscular retraction after five weeks.[64]

Usually several of the causes combine to prevent reduction or resection; it is very seldom that a single cause accounts for it.[65] What influences the results most is the degree of the lesions, the condition of the muscles, the manner in which the operation is performed in regard to asepsis, the individual predisposition; some patients manufacture fibrous tissue so rapidly that it is very difficult to prevent anchylosis, such as rheumatic patients.[66]

The axillary route was advised by Langenbeck, because of the projection of the head into the axilla.[67] It allows an easy resection. But it does not permit reduction if it were possible; it does not enable to clean out the cup; the vessels and nerves are more exposed to being wounded, especially the circumflex; the upper parts of the new and of the old capsules are immova-

ble, and cannot be destroyed, and as they prevent the head from bulging, it renders the resection more difficult.[68]

The posterior route was recommended by Charles Nélaton, but it does not allow of any access to the anterior part of the head and of the adhesions of that part.[69]

The anterior external route is the one which has scored the greatest number of successes.[70] The incision of Langenbeck (acromio-humeral) is a more vertical one than the next one; it gives an easy access to the cavity, but it renders the head less accessible.[71] The interpectoro-deltoid incision is rather farther from the cavity, but it gives better access to the head.[72]

The normal or good condition of the muscles of the shoulder is a circumstance which has been so far too little considered in regard to the probable result of a severe operation (arthrotomy or resection[73]).

A most important point is to get primary union. Suppuration is more frequent in arthrotomy.[74]

The functional result depends specially upon the after management. At first place the arm in the position which keeps best the head into the cup. Next follow the instructions laid down by Ollier in his treatise on *Resection*.[75]

11. *I. D. O. and forward, treated through an axillary incision by arthrotomy and reduction*, is represented by one case only, that of Kocher No. 1, 1889. (See Case II.) The greater tubercle, which was broken off, had to be resected in order to be able to reduce; the capsule was very much thickened. There was suppuration, followed by resection of the head. Seven months after the joint was almost anchylosed.

12. There are eight cases on record of *I. D. O. and forward, treated through an axillary incision by resection*, by Langenbeck, 1860, Lister, 1873, Spieker, 1876, two cases; Langenbeck again in 1877, two cases; Volkman, 1882, and Nélaton, 1888 (see Cases XCIII. to C.)

In Langenbeck's of 1860, the great tuberosity had been fractured; Lister had ruptured the artery in trying to reduce before cutting; Spieker also found the tubercle had been broken off in

his two cases. Nélaton mentions the same complication. In case No. 2, of 1877, Langenbeck found the operation laborious, because the head was more deeply seated than appeared; there was also considerable hemorrhage, requiring the ligation of many vessels, probably the subscapular, in the depth of the wound. Volkman speaks also of great difficulty; the lesser tuberosity was broken, there was hemorrhage due to the injury of the axillary vein by a splinter of bone; the vein was ligated. Nélaton says that the posterior portion of the articular capsule was flattened against the glenoid cavity, was thickened, and did not permit itself to be sufficiently separated to allow the head to be reduced; to overcome this obstacle it would have been necessary to split the capsule crosswise, but the incision having been made in the axilla, the capsule could only be reached with the tip of the finger from deep in the wound, and it would have been difficult to introduce a bistoury; so resection was done. Following the operation, Lister mentioned great shock; there was suppuration in Spieker's two cases; erysipelas in Langenbeck's case No. 2, of 1877; Volkman's, healed primarily; Spieker's No. 1 showed short suppuration; Spieker's case No. 2, long suppuration. Death followed in the case of Lister in three hours, of Spieker's No. 2, from sepsis, and of Langenbeck's No. 2, 1877, from erysipelas and sepsis. The results final are, therefore, three deaths (Lister's, Spieker's No. 2, and Langenbeck's No. 2, 1877); little improved, Langenbeck, 1860, and Langenbeck's No. 1, 1877; improved simply in Spieker's No. 1. This route is, therefore, fraught with danger, and should not be followed in cases of forward dislocations.

13. We found two cases on record of *I. D. O. and forward, treated through a posterior incision by arthrotomy and reduction*, by Schonborn No. 3, 1885, and Mudd, 1895 (see Cases CI. and CII.) Repeated attempts were necessary in the case of Schonborn; the acromion process, which had been detached according to Kocher's method, was with difficulty pressed back into position in Mudd's case. Recurrence of dislocation upon dressing the case took place in Schonborn's. The healing of the wound was even in Schonborn's; primary union took place in Mudd's case.

The results remote were good in Mudd's and not mentioned in Schonborn's.

14. Of *I. O. D., simple and forward, treated by subcutaneous sections of fibrous bands* (tenotomy, myotomy), five cases stand on record: Weinhold-Swanzig, 1819, Dieffenbach, 1839, Simon, 1852, Polaillon, 1882, Mollière, 1886 (see Cases CII. to CVII).

Weinhold picked up a fold of skin; the external portion was incised transversely the extent of a half a finger's breadth from the insertion of the great pectoral, very forcible extension being kept up; while this was accomplished the wound was increased in length to the extent of nearly half a finger's breadth; immediately the humerus approached near the glenoid cavity, and returned in place. The operation was simple in the case of Dieffenbach, it was done in one sitting, when traction reduced the head; Simon did it in three sittings; Polaillon attempted reduction only three days after the tenotomy. There were no difficulties and complications during the operations nor after. There was no suppuration, no trouble of any sort. The results remote are stated as being very good in all five cases. It is astonishing that a method so simple, so safe, and giving such perfect results, should not have been tried oftener. However, when we consider the great difficulties encountered in an open operation before the head can be reduced, when it can be, after the necessary sections have been freely done, it is really most probable that the method has been tried, but has been found wanting, and the failures have not been recorded. It seems best adapted to selected loose cases.

15. Of *I. D. O. forward, treated by osteotomy of the neck*, we could only find one case on record, by Dr. Mears (see Case CVIII.) It was a subcutaneous osteotomy as practised by Mr. Adams. The operation presented no difficulty nor complication, nor were there any complications after the operation. The wound healed without suppuration; the result remote was good for awhile, but later a callus formed, and result final proved to be very unsatisfactory. This ought not to encourage in such an operation.

It is sometimes difficult to decide from the description of the

case if it is a downward (subglenoid, axillary) or a forward dislocation (subcoracoid, preglenoid) that is meant.

16. *I. D. O. and downward, treated through an axillary incision by resection*, are represented by three cases; Langenbeck, 1877, Patterson, 1879, Thomas, 1885 (see Cases CIX., CX., CXI.). There was no special difficulty or complication except that in the case of Thomas the operation was long and tedious, and great difficulty in freeing the head; it had to be removed by slices. In this case of Thomas there was suppuration after the operation. There was primary union in all the cases except Thomas', in which the wound closed at the end of the second month. In this same case there was little improvement; in the two others the final result is not recorded. The operation should be performed, but may prove not so very easy.

17. We found only one case of *I. D. O. and downward, treated by osteoclasia.* It is the case of Desprès (see Case CXII.) It consisted in the deliberate fracture of the neck, so as to be able to bring the arm close to the body; the forced elevation of the arm causing it to press against the acromio coracoid vault or arch, determined the fracture; a cracking sound was heard and crepitation felt. There was no difficulty, no complication, during the operation. There was formation of a callus, it was impossible to obtain a false joint, and the operation resulted in a thorough failure. This procedure should be rejected, except, perhaps, in special cases when a more serious operation is out of the question. It is to be remembered that several cases of fracture in trying to reduce have been followed by fair results.

The writer proposes the following operation in place of subcutaneous osteotomy or osteclasia, in cases where there are no serious pressure symptoms, and the patient is not in a condition from age, debility, etc., to stand a long operation with possible injury to the vessels, and their consequences. After exposing the bone, resect at least one inch of the shaft of the bone where it joins the head, place the resected extremity in or near the glenoid cavity, etc.; begin passive motions early. This procedure leaves the head in an abnormal position, and that is the great objection to it; but it is a simpler operation than the

regular one for reductions or resections in the class of cases above referred to, where the head is firmly bound down.

We have no cases of *I. D. O. and backward treated by reduction in the adult.*

18. There are three cases of *I. D. O. and backward, treated by resection in the adult*, reported by Reid, 1877, Adams, 1888, and Brinton, 1897 (see Cases CXIII., CXIV., CXV.). The cases of Post, 1881, and of A. M. Phelps, 1895, are congenital, and will be considered under that head.

Reid's case was fifty-three years old. The age of Adams's case is not mentioned. No difficulties were mentioned. No complications after the operation are noted. The results immediate are not described. The results remote are: not improved, Reid's case; fair in Adams's. Although these results are not brilliant, they suffice to justify the operation. Brinton's case was complicated with a united fracture below the tuberosities; the final result was satisfactory.

19. *I. D. O. simple, with a limb useful in its new position, to all intents and purposes to the patient*, should not be operated.

20. *I. D. O. and congenital, operated by reduction*, are three in number, operated by Kuster, 1882, No. 3, 1892, and Brown, 1897 (see Cases CXVI., CXVII., CXVIII.). Kuster's case was fourteen months old at the time of the operation, Schede's case was eight years, but the luxation was congenital and intrapartum, as was proved by the doctor who attended the mother's confinement. Brown's child was several months old when operated. In the case of Kuster the head was freed, brought forward and rotated. In Schede's case the head was freed, the glenoid cavity enlarged and deepened, and the anterior part of the capsule removed; the posterior part is freed from the glenoid cavity, and drawn forward so as to cover the head; dislocation reduced; the coracoid process had become larger and longer and bridged over the inner portion of the normal cavity in such way as to prevent reduction; it was separated partially at its base by an osteotomy, and broken so far backward that it no longer prevented reduction. The reduction was easy in Brown's case. There was fever and suppuration in Kuster's case. In Schede's case

suppuration also, and later the greater tuberosity was found to be necrotic and was removed, and the healing was gradual. Brown's case healed kindly. Death resulted in Kuster's case one month after operation. In Schede's case the result was good. Brown's case was much improved.

Remarks. In Kuster's case there was also a similar dislocation on the other side, but it was not operated. In résumé, the operation should be done, as there is no other alternative, but observing the rules governing reductions as set forth.

21. There are three cases on record of *I. D. O. and congenital treated by resection*, one by Post in 1861, and two cases by Phelps (A. M.), 1895 (see Cases CXIX., CXX., CXXI.). (Phelps mentions one case operated by Gerster and four other operated cases, but he gives no references.) All these cases are backward dislocations, subspinous. The operation performed in Post's case was a longitudinal incision made over the posterior edge of the deltoid, dividing the fibres of that muscle, and exposing the head of the humerus, which was found to be dislocated on the back of the scapula. The scapula was denuded and the extremity of the bone turned out; a leaden spatula was pushed beneath the bone to protect the soft parts, and exsection with a saw made of the upper extremity to the extent of three-quarters of an inch. On examining the limb and moving it in different directions it was thought best to remove an additional portion of the bone, the second portion removed being nearly as long as the first; the hand was then brought forward across the anterior portion of the chest, where it lay in a very easy position without apparent difficulty; the edges of the wound were brought together by means of eight twisted sutures made with insect pins. In Phelps's case No. 1 a curved incision was made along the lower edge of the deltoid in the scapula, and the flap turned down; it would, said he, have been better to curve the incision downward and turn the flap upward, as it would give better drainage; the posterior edge of the glenoid cavity was gone; the cavity was about two-thirds the usual size. It was considered whether to enlarge the cavity or trim the head of the bone; it was decided to do the latter, because,

had the cavity been enlarged, it would have been necessary to shorten the humerus in order to replace it, and the result remote might have been, in bringing the two raw surfaces together, anchylosis of the joint. (*Medical Record*, September 21, 1895). A portion of the head of the humerus was cut away in order to fit it into the socket; also cut away a portion of the redundant capsule, posteriorly; the bone was replaced, and a stitch put in behind to help retain the head in place. There was no complication following the operation except in Phelps's second case, which suppurated. The result immediate is not mentioned in Post's case; in Phelps's No. 1 it was very good, and in case No. 2 only fair. The operation is thoroughly indicated. Dr. Phelps says the method promised success the first year, although one case has been operated in which it was successful in the fifth year; he gives no references.

22. *Irreducible dislocation in young subjects*, that is in children and in subjects under seventeen and eighteen years of age, should be treated by reduction, if possible, or by resection of the cartilaginous portion only of the head. It is most important not to injure the epiphyseal cartilage. The ossified portion of the head may be removed, but the epiphyseal cartilage between the head and the shaft must be spared if there is any possibility. A horizontal section with the saw, starting at the internal insertion of the capsule around the head, will surely carry away the totality of the conjugating cartilage.[76] In young children, if the resection is made below the epiphyseal cartilage, the arm will cease to grow. The resected extremity should not be pushed into the glenoid cavity in children, lest the growth of bone cause anchylosis.[77a]

23. *Irreducible dislocations old, in old or debilitated subjects*, should not be operated, except under very favorable local and general conditions, or under serious indications. Resection of one inch of shaft near the head is best adapted to these cases.

24. *I. D. O. and double, i. e., in both sides simultaneously*, and operated, have been reported three times; Lister (2 cases), 1889–90. Reid, 1880.

Lister's first case was operated by reduction on both sides at an interval (see Case III.). The second case was operated by

resection on the right side and reduction on the left side (see Case III.). Reid's case was a double subclavicular, and the two sides were operated by resection at an interval of two and a half months (see Case LI.). These cases have already been considered as regards operation, difficulties, etc. There are two or three more double dislocations reported, but one side only was operated.

25. No case of *I. D. O. spontaneous and pathological, i. e.*, similar to such cases as the coxofemoral articulations, has been found on record.

26. *I. D. O. and paralytic*, are irreducible simply because they cannot be kept reduced, although they are readily replaced in the socket, because the muscles have lost their power through paralysis of their nervous supply from peripheral or central causes. The peculiar joint diseases described by Charcot, specially in connection with locomotor ataxia, are cases also in point. The treatment should be directed to the cause.

In *I. D. O. from paralysis of the deltoid:* expose articular surfaces, pare them, and let them become anchylosed.[77b] The following is a case in point:

1886. Wolff (J.) I. D. O. downward (paralytic), posterior incision, reduction, stitching of head to glenoid cavity, result, improved.

Male, aged 5 years. *Diagnosis:* This was a perpendicular luxation downward of the shoulder, due to severe accident and a traumatic myopathy. The head of the humerus had sunk about three centimetres from the acromion and glenoid cavity, so that one could easily push one's finger into the space between the head and the acromion. *Duration:* Three years. *Movements*, etc.: The right scapula is slightly dislocated on keeping the arm quiet. The lower angle of the scapula stands off from the thorax and the angle, and the lower part of the inner border is nearer the spinal column on the right than on the left side. The arm hangs close to the thorax, and moves like a pendulum when the patient, by changing the position of his body, starts its movement, or when one pushes the arm in any position it will swing back and forth without the will of the patient. The humerus is thereby rotated inwardly, so that the greater tuberosity points inward and the lesser tuberosity backward.

The sulcus (intertubercularis), or sulcus between the tuberosities, is easily palpable, and appears as deep as in the dry bone specimen. Acromion, processus coracoideus, and the upper rounded, depressed, and lowered head are prominent, and are easily distinguishable. Patient raises the scapula and abducts the angulus scapulæ. The arm does not follow the movements of the scapula. When the patient makes a great effort, then he can for a moment raise the caput humeri and scapula, so that it may be at its normal height. More certain, and then only for a moment, the caput humeri will reach its normal height by reflex when one gives the patient a sudden blow on the back. Should the patient desire to elevate the arm, then he moves the arm with the body, outward, with a swinging motion, pendulum-like, and then catches the right hand with the left and raises it. Atrophy of the deltoid is so marked that when one attempts to grasp it with one's fingers, almost nothing can be seized. The supraspinatus and pectoralis major muscles were less atrophied, as well as the muscles of the forearm. However, the muscle pectoralis major is weak, and only acts on fixing the head of the humerus, whereas the muscle latissimus dorsi is under the same circumstances stronger. Every other action of the shoulder-joint is impossible. One can passively move the humerus in any position of luxation or subluxation. The shortening of the injured upper arm in comparison with that of the healthy was two centimetres, of the forearm and hand, one centimetre. Movements of elevation were only possible when the child, by movements of the body, gave motion to the arm like a pendulum. The upper arm is greatly atrophied, and that very evenly on the anterior and posterior surfaces. The elbow-joint, due to the flaccid hanging arm, could not be moved. When the upper arm is elevated and fixed the patient is able to actively straighten the elbow, when it has been previously bent, or if the patient has allowed it to fall by its own weight into a flexed position. If one fixes the upper arm, then rotates it firmly inward, and elevates it to an angle of 45°, then there is a possibility of weak active movements in the forearm. Pronation and supination of the forearm are but slight, and only possible when the forearm is bent. The closing and stretching open of the hand with finger movements can be easily done. On the pectoralis major one notices fibrillar movement, particularly when one breathes or blows on that region. Sensation to pain, temperature, and position, is equal on both sides. No vasomotor disturbances exist.

Eulenburg's electric examination shows a marked decrease of nervous

(irritation) excitement (faradic) in the nerves of the axilla, and less in the plexus over the clavicle; no decrease in the other nerves of the arm. Marked decrease of faradic muscular irritation in the deltoid; has decreased in biceps, triceps, and supinator longus, and no reduction of muscular irritability in the forearm muscles; marked decrease of galvanic muscular irritability in the deltoid; no arterial reaction.

Operation. The arm was abducted so that the posterior border of the glenoid cavity could be easily palpated, and an incision was then made six centimetres long, beginning at the posterior angle of the acromion, along the posterior border of the glenoid cavity downward. This incision laid the joint open. The humerus was then rotated inwardly more than was natural, and so much of the muscular insertions at the greater tuberosity as were necessary to permit of this abnormal rotation were cut away. This permitted a good apposition of the head of the humerus with the glenoid cavity, and after obtaining this marks were made on the head of the humerus and overlying glenoid cavity, as it was intended to knit the humerus to the glenoid cavity by means of ivory pins. The author then chiselled off a thin layer of cartilage on the head and cavity, and drilled a hole through the head of the humerus from inner side to the outer and on the border of the middle and outer third.

In boring of the scapula it was sought to have the hole one centimetre from posterior border, for fear the bone would break off if the drilling were too near the border. In order to do this it was necessary to make a horizontal incision from the middle of the vertical incision through the fibres of the infraspinatus. After boring the holes it was found that the ivory point could not be forced through both holes, as they were not on a straight line, therefore, a strong silver wire was passed through both holes, and then twisted until the chiselled surfaces of the bone were in close apposition. The fixation was so complete that it was not necessary to make another knitting. The author then extirpated a portion of the articular capsule, and left as much as would be necessary for the joint, and then closed the capsule with catgut stitches. Both muscle incisions were then closed with buried catgut sutures, and the skin wound closed with the exception of a small point for drainage.

Difficulties and complications of the operation: ? *Complication after the operation:* ? *Result immediate:* primary reunion; *Result remote;* result better than could have been hoped for. Patient can now, by means of scapula, lift and depress arm, which formerly dangled lifeless.

Against all expectation it has happened that a form of new joint has developed, but with very limited motion, which does, however, permit rotation inward and outward, and even makes it possible upward and downward; no firm union having taken place between head of humerus and glenoid cavity. Head of the humerus fixed to scapula, so that now the patient can slightly raise the arm, also slightly abduct and adduct the same. The author had hoped to obtain an osseous fixation of the denuded head and cavity. This did not result that way. It is, therefore, fixed by silver wire and by the fibrous tissue attached to the openings of the bored holes to the cicatrix, and we have, therefore, a new jointing with limited motion. There is slight rotation. Patient can throw a ball up or to the ground; can walk with a cane in the right hand; also can strike with a stick; can brush his shoes with the right hand, and can also write with it. All these movements could not be made before the operation. No marked progress in movements at the elbow. After operation marked contractions were induced in the deltoid muscle, which previous to it did not react at all. This was the condition four months after the operation.

27. *I. D. O. complicated with persistent atrophy of the muscles, or with muscles not responding to electrical test*, should not be operated, for obvious reasons, unless to relieve troublesome pressure symptoms.

28. The same applies to *I. D. O. complicated with fatty or sclerotic degeneration of the muscles.* It is recognized by the fact that when under an anæsthetic, while the muscles of the opposite shoulder are completely relaxed, yet those of the affected side are still rigid and tense. It calls for section of the unyielding muscles. This sclerotic and fatty condition is not rare in cases of anchylosis of old irreducible dislocations of the shoulder specially, and is often one of the most potent factors in preventing the reduction of the bone even after the head has been exsected.

29. The same applies also to *I. D. O. in subjects rheumatic or gouty*, because they are apt to be followed by anchylosis, especially if reduction has been done; these subjects manufacture fibrous tissue too readily.

30. *I. D. O. complicated with diseases at large* should be treated with the greatest care. Tripier's case is one in point.

31. *I. D. O. complicated from having been subjected to great efforts at reduction* should not be operated for some two or three weeks, lest we find bruised tissues, extravasated blood, etc., which may be the causes of suppuration and sepsis. Langenbeck, 1877, is one example (Case XCVII.); also Kocher, No. 3 and No. 6, 1889 (Cases LXV. and LXVIII.).

32. *I. D. O. complicated by arthritis acute should not be* operated until the acute state is over.

33. *I. D. O. complicated with chronic arthritis or with suppuration* are reported by Reid, 1878 (Case L.); Bardeleben, 1889, (Case LXIII.); Fenger, 1889 (Case LXII.); Schede, No. 2, 1892 (Case XXIII.); Bellamy, 1887 (Case LIX.). They should be operated as soon as possible.

34. *I. D. O. complicated with anchylosis of the head in the pseudo-cavity* is mentioned by Post, 1861 (Case CXIX.); Hofmokl, 1881 (Case LIII.). They usually present great difficulties, specially if the anchylosis be fibrous and close, but particularly if it be osseous.

35. *I. D. O. complicated with pressure symptoms of the vessels and nerves* should be operated, if only for the relief to be obtained, provided no serious contraindications exist.

36 and 37. In *I. D. O. complicated with fractures during attempt at reduction soon, before, or during the operation*, if the fracture is very *high up*, it is safest treated by resection of the broken head; when the *fracture is in the middle*, the head should be resected below the ball and the balance of the fragment brought in opposition with the lower fragment. Thiersch's case, 1874, is an example (Case XLV.). We will recall here the following cases of *O. D. and new fractures* of Kocher's, 1889–90. In case No. 2 (Case LXIV.), one week before operating an attempt to reduce was made and the bone fractured through the anatomical neck; the greater tuberosity was torn off, also the subscapular, the short head of the biceps; the fractured head was resected or removed, and the result was good. In case No. 4 (Case LXVI.), attempt at reduction before operating was followed by fracture of the head of the humerus, the fracture line passing also through the greater tuberosity; resection of

the head, result good. In case No. 5 (Case LXVII.) there was an old united fracture of the head through anatomical neck, and of the tuberosity; the bones were refractured in the manipulations to try to reduce before operating; the fractured bones were removed, with an improvement of the case. The same accident—*i. e.*, refracture—happened to Erdmann, 1896 (Case XC.), and to Vander Veer, 1897 (Case XCI.).

38. *I. D. O. complicated with injury to the vessels before operating*, and followed by an operation, is represented by the classical case of Lister, 1873 (Case XCIV.), a rupture of the axillary artery.

39. *I. D. O. complicated by injury to the vessels during operation* has been recorded in the case of Annandale, 1875 (Case XLVII.), (circumflex and axillary arteries); Langenbeck, No. 2, 1879 (subscapular artery), (Case LXVIII.); Hofmokl, 1881; Volkman, 1882 (sulclavian vein), (Case XCIX.); Vander Veer, vein and artery, axillary (Case XCI.). The injury to the vein rendering ligation necessary, and followed by threatening gangrene, calls for the deep consideration of the advisability of ligating the axillary or brachial artery below the largest collateral. Injury to both artery and vein or uncontrollable hemorrhage must be met as done by Vander Veer, by amputation of shoulder.

40. *I. D. O. complicated with old fractures, non-united, of the tuberosities*, call for the resection of those pieces, which are usually connected by more or less numerous short, dense, fibrous bands.

I. D. O. complicated with old united fractures of the tuberosities, of the anatomical neck, and of the surgical neck are common—36 per cent. of all forward dislocations. They are usually surrounded by such a great amount of fibrous tissue or by such callous as to render the operation more difficult. The partial resection of the tuberosities is sometimes required to obtain room to work, as in the Bickham and Souchon case.

41. *I. D. O. complicated with old united fracture of the shaft* are not likely to give trouble, being low down.

42. *I. D. O. complicated by a previous unsuccessful operation*

give great trouble, as proved by the case of Bickham and Souchon (Case LXXXV.), where the adhesions between the surgical neck and the surrounding parts were great and resistant; also between the cartilaginous surface of the head with the surrounding tissues. The head was much hypertrophied; it had to be partially resected with the gouge and hammer to make room to continue the operation; it was also very hard, almost eburnated—all this due to the long suppuration that followed the first attempt.

I. D. O., recurrent or habitual, are irreducible in that they cannot be kept reduced.

43. *I. D. O. recurrent, treated by stitching of capsule* (reefing), are reported by Ricard, 1892. Two cases (see Cases CXXII. and CXXIII.). An anterior incision in the pectoro-deltoid interstice; at the upper end the incision is prolonged at right angle, following contour of the insertion of the deltoid to the clavicle and acromion; the muscle is detached and turned outward and backward; the coraco-brachial is then lifted by an assistant; the operator frees the upper or inferior edge of the subscapular muscle at its humeral insertion; the arm is then rotated inward firmly, so that the anterior wall of the capsule is relieved of tension; then through the top of this wall, through the capsule, and into the thickness of the subscapsular muscle the operator passes three stitches of a coarse flat silk, vertically directed, and about two centimetres one from the other. The free extremities of these threads are tied, two by two, in order to reduce this anterior wall to the least but most resistant and rigid thickness. There were no difficulties or complications during the operation nor after; the results immediate were not mentioned. The patient is reported as keeping well during the nine months following the operation, when he was employed wheeling a wheelbarrow. This surely is the ideal operation for habitual dislocations.

44. *I. D. O. recurrent, treated by incision of capsule, overlapping, and stitching*, is the first case of operation reported for recurrent dislocation by Samosch in 1889. (See Case CXXIV.) Through an anterior incision the capsule was reached and split longi-

tudinally; the medial portion was drawn over the lateral and pulled strongly and stitched in this position. No difficulties nor complications are mentioned; the healing was primary and the final result very good.

45. We found three cases of *I. D. O. recurrent treated by resection of portion of the capsule and stitching:* One by Gerster, 1884, and two by Burrell, in 1897. (See Cases CXXV., CXXVI., and CXXVII.)

Gerster's is a case where reduction was effected without any difficulty, the arm put up in a plaster bandage for five weeks. Upon the removal of the bandage the dislocation reappeared, and the mere weight of the extremity alone was sufficient to cause the reappearance of the dislocation. An anterior incision was made and the capsule exposed; its inner aspect, the side facing the axilla, was abnormally relaxed; a piece one inch long and two in width was excised from it, while the arm was firmly rotated outward. A counter-incision was made into the posterior part of the capsule for drainage; closing of the anterior incision. There was no difficulty nor complication during the operation. Septic fever set in a few hours after, due to the catgut drain; it was removed and replaced by a drainage-tube; wound treated openly. There was long suppuration, with erysipelas. After the healing, the functions of the joint were fair and promised to improve.

Burrell proceeds also through an anterior incision; the operations were more elaborate and systematic, presented no difficulties nor complications, healed primarily and gave very good results.

The cut which accompanies his description shows the field of operation; it is a drawing from a dissection made to demonstrate this operation, by Dr. F. B. Lund. The important detail which is shown in the cut is the divided tendon of insertion of the pectoralis major. This allows the retraction inward of this muscle, uncovering the capsule of the joint. In order to gain access to the joint the subscapularis muscle should be partially divided. Then, with hooked retractors, a piece of the capsule can be excised.

The following description gives in detail the operation:[79]

The patient was etherized and the arm slightly abducted. An incision was made from the coracoid process downward and outward, following the line of the cephalic vein to below the upper border of the tendon of the insertion of the pectoralis major. The cephalic vein was then recognized, drawn outward, and the intermuscular septum between the deltoid and the pectoralis major was separated with the handle of the scalpel and with a few touches of the blade. This exposed in the upper part of the wound the coraco-brachialis and short head of the biceps, and in the lower angle of the wound the upper part of the insertion of the pectoralis major.[80]

The acromio-thoracic artery was distinguished; the upper three-quarters of the insertion of the pectoralis major was divided, in order to allow the muscle to be retracted inward and thoroughly expose the head and neck of the bone. These now came into view, and in front of the head and neck of the bone could be seen and felt, through its sheath, the long head of the biceps. It was found necessary to clear the tendon of the coraco-brachialis, short head of the biceps quite up to the coracoid process, and to carry the incision in its whole depth up to the coracoid process.[81] By externally rotating the arm and dropping it backward the insertion of the subscapularis muscle could be distinguished, and its tendon was stretched over the head of bone. A portion of this insertion was divided. The finger felt the head of the bone, the anterior two-thirds of which was very plainly exposed, and it tended to slip forward toward the coracoid process. The coracoid process could be plainly distinguished, and the capsular ligament was apparently lengthened.[82] The arm was then abducted to an angle of 45°, and the head of the bone pressed backward to prevent the head from coming up under the coracoid process. By these means the front of the capsule was grasped with a three-pronged vulsellum forceps. Three sutures were inserted with a curved needle beneath this, and this fold of the capsule was excised three-quarters of an inch in length and five-eighths of an inch in width.[83] Two of the sutures were cut out at the time of re-

moving the bit of the capsule. The other suture held and was tied. Another suture was introduced into the capsule. After these sutures were tightened and tied it was found that the capsule was distinctly tighter and shorter.

The acromio-thoracic artery was divided, and was the only vessel requiring ligature. Sterile water was used for irrigation. Silkworm-gut sutures closed the whole length of the wound. No attempt was made to unite the partially divided insertions of the pectoralis major and of the subscapularis, as when the arm was brought to the side these structures came together without suturing. The wound was dried; an antiseptic dressing was applied, and the arm fixed to the side with the hand across the chest.[85]

A clear differentiation must be made of all the anatomical structures, and with this accomplished, the operation is feasible. The use of broad retractors without sharp points, on the inner side of the wound, to retract the coraco-brachialis and the vessels, is of great importance.[86] The important steps in the operation are: The free division of the tendinous insertion of the pectoralis major for three-quarters of its breadth, in order that the head of the bone and capsular ligament may be freely exposed by retracting the muscle; the division of a portion of the subscapularis; raising the arm to a horizontal plane and pressing back the head of the bone, which relaxes the front of the capsule so that it can be grasped and a bit removed.[87]

The result of the operation in the first case (Case V.) is that a year and ten months after the operation, the patient, when seen, stated that there had been no recurrence of the dislocation; that he had been fishing on the Grand Banks during the summer of 1896, and that the motions of the joint were perfect.

In the second case, at the end of two months the patient is using the arm freely, and has had no recurrence of the dislocation.[88]

The first operation took one and three-quarter hours. The second took thirty-five minutes. It is purely an anatomical operation, and each anatomical structure must be recognized as carefully as in the ligation of an artery. So far as one can

generalize from these two operations, it is simple, efficient, and curative.[89] This operation is a more severe one than mere stitching, and should be reserved for when the stitching fails.

46. There is one case reported by Albert, 1888, of *I. D. O. and recurrent treated by reduction* (see Case CXXVIII.). The joint was penetrated through a posterior sinus; the head and glenoid cavity were deprived of their cartilages and stitched together. No complications followed the operation, but it resulted finally into anchylosis of the joint.

47. The cases of *I. D. O. recurrent treated by resection of the head*, was reported by Cramer, 1882, Porter, 1882, Sacré, 1883, and Owen No. 2, 1893, Monks, 1896 (see Cases CXXIX. to CXXXIII.). They were all subcoracoid dislocations. The operation consisted in an anterior incision; Langenbeck acromio-humeral was used by Cramer. There were no difficulties, no complications during the operation, nor any complications after. They all healed by first intention, except Porter's case. The results remote were: Fair in the case of Cramer and Owen, good in Sacré's, and improved in Monk's. This operation strikes one as a rather severe one when contrasted with the result of Ricard. It is true in the latter's case there was no rent of the capsule; but when this exists it should be pared and stitched. Excision of the head of the humerus is a mutilating operation, and will be very rarely necessary. It is conceivable that after an exploration of the joint, abnormalities might be found which would demand an excision.[90]

48. *I. D. O. operated by resection and reduction and followed by long suppuration* has been met with in 32 per cent. of all forward dislocations. This is, indeed, too much, and calls for the greatest care in asepsis and antisepsis in the future. The head had also to be resected after reduction in the case of Kocher, No. 3, 1889, a case of forward dislocation operated through an axillary incision (Case XCII.), also Socin's case, 1885, reduction, necrotic pieces, then resection (Case VII.); also in Schede's case No. 3, 1892, backward dislocation, congenital, reduction, necrosis of greater tuberosity (Case CXVII.). The same remarks apply here with much greater force. It shows also how considerate the surgeon should be before reducing instead of resecting.

49. *I. D. O. operated by resection or reduction*, and followed by necrosis of the bones, is recorded in 2 per cent. of the resected cases, as against 16 per cent. of the cases reduced of forward dislocation.

50. *I. D. O. operated by reduction and followed by anchylosis of the head in the old glenoid cavity* is one of the dangers inherent to reductions. It has been observed, specially when the surfaces were tightly bound down and when the after-treatment had not been most carefully attended to from the beginning.

51. *I. D. O. operated successfully by reduction, and followed by recurrence and anchylosis in the pseudo-cavity*, is mentioned by Albert, 1888, a recurrent case.

52. *I. D. O. operated by resection and followed by anchylosis of the sectioned extremity of the humerus in or near the glenoid cavity* have been observed, specially in the case of Kocher No. 4, 1889 (Case LXVI.), and of Bickham and Souchon, 1895 (Case LXXXV.). Cases requiring the resection of the superficial head are apt to be followed by anchylosis. For this reason it is best in adults to resect more extensively than is actually necessary to produce movement, but in young subjects, especially in children, as said before, the great importance of not injuring the epiphyseal cartilage will render the opposite course the rule to be guided by. This anchylosis of the sectioned extremity may require either section of the muscles or resection of the anchylosed extremity. The latter is often a laborious undertaking on account of the extensive and resistant adhesions, due to the fact that the parts have already been operated upon before. The muscles are also retracted and degenerated in these cases. This condition is often due to improper consecutive or after-treatment, either because it was not begun soon enough or was not kept up long enough.

53. Sometimes *I. D. O. operated by resection is followed by dislocation of the sectioned extremity of the humerus under the acromion or under the clavicle under or inside of the coracoid process*, forming an acromio-humeral or a coraco-humeral or a cleido-humeral articulation instead of a glenoido-humeral. Ollier mentions a case where he had a great deal of trouble to prevent

it. It was observed in a case of Weinlechner, 1876 (Case XLIX.). It is usually the result of improper attention to after-treatment at the proper time. In one case reported by Luckie the resected extremity articulated with the under surface of the acromion (Case XL.). There was an articular capsule between the humerus and the inferior surface of the acromion. This latter was covered with fibrous tissue, the small humeral head which projected into the capsule is a small projection as large as a pea, which was lined with hyaline cartilage. Outside of the articulation osteophytic processes extended into the muscular insertions; the glenoid cavity was lined with fibrous tissue and connected with the humerus by bands of connective tissue.[91] The case was an old patient of Langenbeck (it is related by Luckie[92]). Of course, such occurrences interfere very much with the movements and may destroy the result of the operation.

54. *I. D. O. operated by resection is sometimes followed by anchylosis of the sectioned extremity of the humerus, under or inside the coracoid process.*

55. *I. D. O. operated and followed by anchylosis of the pseudo-joint*, due to hypertrophy or irregularity of the new ossification, is only seen in cases of subperiosteal resections. New resection may be attempted, but may not do much good, on account of the condition of the tissues of the region. If there is only one bony projection, it should be excised.

56. *I. D. O. operated and followed by dry arthritis of the pseudo-joint* is observed specially after reduction, but also after resection when the subperiosteal method has been followed and a new head has been formed. It should be treated on general principles, unless too painful, when a new resection has to be made, but extra-periosteally. After a few years they present modifications analogous to those of ordinary dry arthritis. The joint becomes stiff and cracks. This is especially observed in rheumatic and tuberculous subjects; in the latter, caries may develop.[56]

57. *I. D. O. operated by resection and a dangling arm* is often the result of an extensive resection or an unnatural condition of the muscles. Prothetic apparatuses place the arm in the same

condition as if it was anchylosed. When the distance between the resected humerus and the glenoid cavity is only six or seven centimetres, the extremity should be pared and stitched to the glenoid. When the distance is greater, the same should be done and the bone stitched as high up as possible. Bone-grafting may be very useful, especially fragmentary grafting. (Ollier.)

REMARKS CONCERNING THE OPERATIONS, ESPECIALLY BY RESECTIONS.

The following points, from able authorities, but mostly from the admirable book of Ollier,[93] should be well borne in mind by operators, especially in operations by resection. They are transcribed here, from a previous paper by the writer on anchylosis of the shoulder, for the convenience of the reader.[94]

Lagrange states that Boucher was the first who thought of resecting the upper extremity of the humerus, but it was White, of England, and Vigarous, in France, who performed the first operation.[95]

In 1789 a boy presented with his right hand to the Academy of Surgery the head of his right humerus, which had been resected by the surgeon-major of the regiment du Berri.[96] But Ollier asserts that Bent, of Newcastle, in 1771, was really the first who resected the humeral head.[97]

Post, of New York, in 1861, was the first to resect for irreducible dislocation; the next one was Warren, of Baltimore, says Ollier.[98] However, we report a case of Langenbeck dated 1858.

Ollier was the first to recommend (1858) the preservation of the capsule-periosteal sheath without cutting the muscles, as a means of obtaining a new joint, and, if possible, to cause the formation of a new head.

Langenbeck's incision, starting farther behind the internal border of the acromion, sacrifices the inervation of a greater portion of the deltoid.[99]

Ollier's rule is to expose the head by an incision as near as possible to the antero-internal border of the deltoid, and, if necessary, by the disinsertion of its internal portion.[100]

The incision should never be made internally (in axilla), on account of the nerves and vessels, except in rare cases of subglenoid dislocation, where the head projects near the skin.[101]

The deltoid is the most important of all the muscles, as is demonstrated by the cases of paralysis of the circumflex nerve, when the insufficiency of the muscles which are inserted on the head become evident.

The preservation of the circumflex nerve is also of great importance.[102] This nerve runs parallel to the posterior border of the acromion, from which it is distant in an ordinary adult by five and a half or six centimetres. This is important for the limit of perpendicular incision and for the incision for the drainage-tube behind.[103]

The loss of the elevating action of the deltoid must be accepted, like the loss of the rotating power from the division of the muscular insertions into the two tubercles, as a necessary consequence of resection of the head of the humerus. But the holding or supporting power of this muscle, exerted upon the whole of the upper extremity, owing to its position, its extensive origin, and the manner in which it embraces and protects the mutilated parts, as well as its faculty of carrying the arm backward and forward, are all functions which may still remain and serve the point to the great importance of preserving its integrity as fully as possible The wasting of the internal fibres, however, seems a necessary result of resection by the single incision, but it has this compensating feature, that it is a less serious loss to the patient than an atrophied condition of the outer and posterior fibres would be, because the upper clavicular fibres of the great pectoral can take the place of the inner deltoid fibres to a considerable extent in supporting the shoulder and drawing it forward to the chest.[104]

The movements of elevation are seldom required, save by those who follow climbing occupations, as sailors, masons, etc.

The mode of performing the operation, as well as the operation itself, will naturally influence these movements. If the deltoid be cut completely across, by means of an elliptical incision, the power of abduction of the arm and its elevation may be

permanently lost. If its fibres be merely split by a longitudinal incision they may be preserved or regained in great part.[105]

The incision shall be as forward as possible, because all that portion of the muscle which will be to the inner side will be paralyzed. It is best to avoid the interdeltoido-pectoral groove on account of the cephalic vein; make the incision a little behind.[106]

In exceptional cases the clavicular portion of the deltoid may be disinserted—*i. e.*, by section of the insertion near the bone, without preserving the continuity with the periosteum. It is different from the subperiosteal detachment of the muscle done with the gouge.[70] The disinsertion of the clavicular portion of the deltoid, in part or in totality, is especially indicated when the head of the humerus is bound down and the arm cannot be separated from the chest.[107]

The relations of the large vessels and nerves must not be overlooked. However, in subperiosteo-capsular resections they run no risk as long as the operator remains within the capsulo-periosteal sheath.[108]

A great effort should be made always to recognize the tendon of the biceps and take care of it. If torn or cut it must be stitched back.

To obtain satisfactory results, especially in reductions, it is the portion of the capsule that the surgeon must get out of the way of the humerus and of the cup. Therefore, it is particularly behind the displaced head that he should dissect, and not so much in front as has been done heretofore.[110]

As one of the chief drawbacks of the operation is the poor amount of abduction and elevation which remains, owing, in a large measure, to the humerus being too short to be brought into the glenoid cavity when the deltoid acts, Holmes thinks that in this joint a trial of the subperiosteal method should be carefully made to insure as much reproduction of bone as possible.[109]

The resection should be done economically. First saw through the anatomical neck (see Kocher, No. 3, 1889). If the reduction is not possible saw a slice off and try then to reduce; if neces-

sary, saw off another slice, or saw through the surgical neck. When the humerus is put back in place it must be neither too loose, because there will result a flake limb, nor too tight, because it may become anchylosed, partially or totally; this is worse than a loose joint, and has often happened.[111]

It is impossible to say how much of the head must be resected to reduce the dislocation. Sometimes a superficial resection of the convexed articular surface is sufficient to replace the head, but it must be remembered that the head must be maintained in the cup. A resection below the head insures a better false joint. A too close resection may be followed by anchylosis.[113] Only the head of the humerus without any of the shaft should be removed. However, it is best to remove too much of the head than not enough. The subperiosteal method is the best; too much dissection of the bone may cause necrosis.[114]

Ollier says to be careful about the replacing of the extremity of the humerus, because the fibrous tissue might form a sort of interarticular cartilage between the end of the humerus and the cup. It will be well to stitch the fibrous tisues so as to form a sort of capsule.[112]

After the head has been resected the cup should be cleared, so as to make sure that the extremity of the humerus will readily remain in the cavity, otherwise that extremity itself may become displaced (or dislocated) under or inside the coracoid process.[115]

When feasible, the capsule should be restored as much as possible over the reduced head or over the resected extremity.

Ollier described several cases of reproduction of bone after the subperiosteal method.[116]

Langenbeck mentions a case in which the whole shaft of the humerus was necrosed and was removed, the elbow-joint was resected at the same time, and yet the reproduction of bone was so complete that the shortening was no more than one and one-fifth inches. The new humerus broke several times, but the movements of the shoulder and elbow were satisfactory, and the hand capable of the most delicate movements.[117]

In cases of rarefaction of the bones, it is important to seize

the head with strong tooth-forceps; ordinary forceps mash the head.[118]

The posterior drainage incision must be made at the most dependent part when the patient is lying down; this depends upon where the resection has been made. Care should be taken not to wound the circumflex nerve nor the artery. When the incision is made very low down, it is the musculo-spinal nerve that must not be wounded.[119]

It is best to place the tube even in cases where the bones are not diseased.[120]

In adults the rule is to push the resected extremity into the glenoid cavity when regeneration of the bone is expected.[121]

A thick pad should be placed in the axilla to prevent the humerus from being drawn inward.

The preservation of the deltoid roundness is a peculiarity of the subperiosteal resection.[122]

The following *remarks concerning the after-treatment* are most important:

The sooner the passive movements are begun the better, a few days after the operation, because the resected humerus may become anchylosed.[123]

The more the wound healing progresses the more the movements should be extended.[124]

The muscles, especially the deltoid, must be soon massaged and electrified.

It is especially in operations upon the shoulder that the after-treatment is of importance. Too much care cannot be given to that after-treatment; if incomplete or stopped too soon, almost all the benefits of the operation may or will be lost.[125] It must be kept up for weeks and even months.[126]

Extensive movements, especially those of abduction, should not be practised until several weeks after the humerus is sufficiently fixed in the glenoid cavity, lest the resected humerus may pass under the coracoid process, where it may form a coracoid articulation instead of a glenoid.[127]

The re-establishment of the complete mobility is retarded by thickening of the capsule, which in some cases is shrunken, and

in some points is as resistant as cicatricial tissue; also to the fibrous and fatty degeneration of the muscles.[128] This condition of the muscles is all the more difficult to overcome because the other muscles instinctively take their place, especially those that move the scapula.[129]

Rotary movements must be begun as soon as there is no pain.[130]

Electricity, massage and gymnastic exercises, must be conducted slowly, carefully but continuously, every day.[131]

Remarks concerning the final results are most interesting. In a number of cases of resection of the head operated on by Percy (1795) for various causes, the movements were all good except that of elevation, and the arm had to be rested against the chest to work the forearm, which then enjoyed all its strength.[132]

In order to appreciate the usefulness of the new joint, the following manœuvres should be practised. To measure the force of the abduction, *i. e.*, of the action of the deltoid, weights should be fastened to the elbow, and the patient directed to raise the elbow outward, first without and then after fixing the scapula. Then do the same with the weights attached to the forearm or placed on the hand.[133]

To measure the movements of rotation, flex the forearm against the anterior surface of the thorax, and place some object in the hand; then fix the elbow and make the hand describe the arc of a circle from inward outward, keeping the elbow well fixed.[134] In doing this we must watch the actions of the other muscles inserted in the humerus, which by the successive contraction of their various parts, may at a given time become rotators.[135]

The patient should be made to cross the arms, to place the operated arm behind the head, on the forehead, behind the back, on the buttock, throw a stone, etc.[136]

Some patients may perform some energetic movements and yet feel hampered in delicate movements requiring rotation. The resistance of a fibrous band or the existence of an abnormal projection on the new head explains these discrepancies.[137]

As for the conditions of the new joint, after resection from

various causes, out of 213 resections Gurlt observed 96 tight articulations, 21 anchylosis, and 76 dangling limbs.[138]

A few *remarks concerning the findings in the autopsies of operated cases* are now in order. In some cases there is formation of a new head, more or less irregular.[139] These gave an almost ideal result. In one case Testor found an intra-articular cartilage.[140]

Chaussier, Roux, Lyons, Breen, Hutchinson and others, have dissected articulations of shoulders resected from three months to twenty years. They all found a fibrous cord, strong and resistant, joining the humerus to the scapula, and adherent by its external surface to the surrounding soft parts, more or less atrophied. But they never found a real articulation.[141]

Ollier reports several cases of reproduction of bone after operation found at the autopsies.[142]

HISTORIES OF CASES OF I. D. O., SIMPLE, FORWARD, OPERATED THROUGH AN ANTERIOR INCISION BY ARTHROTOMY AND REDUCTION.

CASE I. *1820. Wattman.*[143] I. D. O. forward (infra-clavicular) anterior incision, arthrotomy and reduction, improved. Sex, ? age, ? *Diagnosis:* Infra-clavicular dislocation. *Duration:* Eleven months' standing. *Movements*, etc.: Paralysis, atrophy of muscles, pains. *Operation:* Vertical incision four inches in length, midway between the joint cavity and the dislocated head. After division of the anterior border of the deltoid, the head was at hand. *Difficulties and complications of the operation:* On the outer surface of the neck of the humerus was found an elevation allowing of but little displacement, which, on being examined, was found to be a broken off piece of the glenoid cavity. The glenoid cavity was filled with soft tissue; the surrounding soft parts had to be separated with a scalpel before room could be made in the joint cavity for the reception of the head of the humerus. Attempt to place the head in its normal site with the fingers was fruitless; supraspinous had to be incised to a point near its insertion into the humerus before it was possible to place the head in the nearly flat joint socket, using a lever pushed in between the head and the coracoid process, and resting on the fragments of the joint rim. *Complication after the operation:* The edges healed by primary intention, but much suppuration followed and burrowed along the arm and toward the

scapula. *Result immediate:* Healed gradually. *Result remote:* The movements which could be made by the patient at the time of his discharge (date not given) were still very limited; however, it was expected that by means of assiduous practice, which was urged upon the patient the motions would in the course of time grow more extensive. *Remarks:* Efforts at reduction were made immediately after the occurrence of the displacement, but failed.

Case II. *1873. Lister No. 1.*[144] I. D. O. forward (subcoracoid), anterior incision, arthrotomy and reduction (left side), result good. (There was an I. D. O. on right side which was treated by resection. See resections). Man, aged 23 years. *Diagnosis:* Subcoracoid dislocations of both shoulders. *Duration:* Seven months. *Movements*, etc.: He had absolutely no use of his arms; there was extreme atrophy of the muscles of the shoulder, however; there was considerable movement between the scapula and the body. *Operation on left shoulder:* Lister proceeds thus: The head being exposed by an incision beginning at the coracoid process, and prolonged along the pectoro-deltoid groove, he detached the capsule internally and externally to the surface of the insertion of the external rotator muscles. The detachment of the posterior portion of the capsule transforms the capsule into a flap, which the head can push asunder to return to its place. This proves that to obtain a satisfactory result it is the posterior portion of the capsule that the surgeon must get out of the way of the humerus and of the cup, and that it is behind the displaced head that he should dissect, and not in front, as has been done heretofore. With the aid of pulleys the head of the bone was returned to its normal position. *Difficulties and complications of operation: ? Complications after the operation: ? Result immediate:* The wound healed in six weeks. *Result remote:* Under the influence of passive motions, massage and galvanism, he improved so much that he could dress himself and perform the other acts of toilet, being no longer dependent upon others. *Remarks: ? Operation on right shoulder:* (Six months later. See Resections.)

Case III. *1873, Lister No. 2.*[145] I. D. O. forward (subcoracoid), double, *i. e.*, on both sides simultaneously, anterior incision, reduction on both sides, result good. Sex: male. Age: 47 years. *Diagnosis:* Subcoracoid luxation of both shoulders. *Duration:* Nine and a half weeks. *Movements*, etc.: Unable to dress himself, arms almost fixed in slightly abducted position, and rotation very limited, partially on right side. *Operation on one shoulder, left side:* Incision from the coracoid process downward and somewhat outward in the interval be-

tween the deltoid and the pectoralis major. Divided the tendon of the subscapularis muscle at its insertion, and then with a periosteum detacher proceeded to separate the soft parts from the head of the bone and the inner part of its neck. *Difficulties and complications during the operation:* Made sure that the vessels were entirely detached from the bone; pulleys were applied; as the pulleys dragged on the humerus, some fibrous bands were felt to be put on the stretch; these were divided; the head of the bone still refusing to return to its normal position, the bone was completely cleared and pulleys again applied; this failing, the head of the bone was protruded through the wound as if for its resection, the external rotators having cut through at their insertions; pulleys again applied, direction and traction being altered from time to time by changing the position of the operating-table; pulleys were then suddenly relaxed by pulling a slip-knot arranged for that purpose, and at the same time rotation outward and adduction of the limb were performed; the head of the humerus was then brought nearer to the glenoid cavity; it went still nearer at the second attempt, and at the third slipped into its normal place. *Complications after the operation:* None. *Result immediate:* Good. *Operation on other shoulder:* Following week operated on other shoulder in similar manner except that I at once protruded the head of the bone dividing the attachments of all the rotators. In this instance at the second attempt the pulleys drew the bone into its proper position. *Complications after the operation:* None. *Result immediate:* The wound on this side, as on the other, remained without disturbance. *Result remote:* Five months after the operation patient presented with shoulders in their natural rounded form, and stated that he could do any hard agricultural work as well as ever. He exhibited all natural movements except elevation, which he could not do far above the horizontal; but states that he found improvement in that respect. *Remarks.* ?.

Case IV. *1874, Albert.*[146] I. D. O. forward (subcoracoid), anterior incision, arthrotomy and reduction, old fracture of surgical neck, results good.

Man ?; age ?. *Diagnosis:* Subcoracoid dislocation. *Duration:* ?. *Movements*, etc.: ?. *Operation:* Incision about eight centimetres, anteriorly, in such a manner as to have access to the region between the head of the humerus and the socket; divided many bands which stretched across; then began making rotary movements; the head moved nicely toward the socket. *Difficulties and complications of the operation:* The head was on the point of slipping back into this when

the neck of the humerus suddenly snapped; the head was drawn into the socket by using two steel hooks and pressing it into the socket; then the fragments were sutured together. *Complications after the operation:* ? *Result immediate:* ? *Result remote:* Formation of a pseudarthrose at the surgical neck, which, however, gave a useful limb. *Remarks* ?.

Case V. *1878. Buckhardt (H.).*[147] I. D. O. forward (subcoracoid) with old fracture of tuberosity, anterior incision, arthrotomy, extensive muscular dissections, reduction, result good.

Female, age 48. *Diagnosis:* Luxation (forward and downward). *Duration:* Seven months. *Movements*, etc.: Marked atrophy of shoulder muscles. Movements of all parts of arm much limited. The upper arm was in a position of abduction, at an angle of 15°; was entirely immovable actively, and only very slightly movable passively. Patient suffered much from pain in arm and a feeling of heaviness; extent of pain did not correspond to special nerves. *Operation:* Incision 13 centimetres long half-way between acromion and coracoid process, through skin and deltoid. Incision continued along glenoid cavity, and on upper arm deepened for a distance of 3–4 centimetres, and then the fibrous tissue was all cut away. Glenoid cavity covered by a very thick layer of fibrous tissue which extended downward upon the arm without any apparent break; the freeing of the socket by dissection with scalpel and elevator extremely difficult on account of firm adhesions; no remains of cartilage were discovered; in the outer half of the layer which had been dissected away was the biceps tendon, forming an integral part of it; head bound down on all sides by dense connective tissue, also the portion of the shaft lying next to the rim of the joint; reduction impossible, even after freeing the head of the humerus; division of the muscular insertions on the inner surface to the extent of one or two centimetres; glenoid cavity was freed; head after manipulation and more separation from adhesions, and after cutting the insertions of muscles subperiosteally, was finally reduced. The greater tubercle, which had been broken off, was removed. Drainage-tube inserted through wound and brought out in back, and another inserted at lower angle of wound. Muscles and skin sewed up tight except where there were drainage-tubes. Arm put up in aseptic bandage with an axillary pad. *Difficulties and complications of the operation:* Due to the fibrous tissue about the cavity and head of the humerus and to the resulting adhesions which had taken place. One centimetre below the anatomical neck was extirpated an irregular

bony projection of the size of a bean, presenting rough prominences; this projection, which was situated in the fibrous tissue, was evidently the partially broken-off greater tuberosity. *Complications after the operation:* In order to lessen the pressure of the head on the socket, permanent extension was tried; but this had to be discontinued owing to too great discomfort from it. *Result immediate:* Wound remained septic until quite healed. Bandages had to be removed once or twice some hours after the operation because of red blood soaking through; four weeks after operation pus was still coming away from the drainage-tube which led up to the old site of the head. Front drainage wound closed three and a half weeks after operation. Eight weeks after the operation the posterior wound closed. One small stitch-abscess formed in first three weeks. Active and passive motions, carefully practised, were begun in the second week; after the eighth week they were practised with great boldness after the drainage opening had closed. *Result remote:* Three and a half months after the condition was as follows: the patient was free from pain; the arm could be raised in the horizontal plane through an arc of 45°, the elbow could be brought forward almost to the middle line of the thorax; posteriorly the right hand could reach the left iliac spine; she used her hand in eating or drinking, and combed her own hair. Passive motion was far more extensive. The most limited motion was that of external (outward) rotation (an arc of 10°–15°). The deltoid muscle was still markedly atrophied, but its contraction was plain to the eye. The head of the humerus was a little deep and somewhat nearer the median line than in the normal. After ten years there was no improvement on the above; the deltoid is completely atrophied, the shoulder markedly flattened, the head of the humerus smaller and pressed (jammed) against the inner and lower margin of the glenoid cavity; pressure over it causes pain; for instance, the patient cannot lie on that side. The woman can, without assistance, bring the arm so far forward that she places her hand on the occiput; then with the help of the other hand she can place it on the vertex so as to be able to dress her hair. Abduction can be performed through an arc of not quite 45°, and rotation is at a minimum. The muscular development of the arm, and especially the forearm, is great; the elbow and finger-joints are strong and fairly movable. She carries buckets of water and other heavy articles by preference with the affected side, as the extension of the arm thus produced is agreeable to her. *Remarks* ?.

Case VI. *1878. Albert.*[118] I. D. O. forward (subcoracoid), anterior

incision, arthrotomy, reduction, result good. Woman, aged 45 years. *Diagnosis*: Subcoracoid dislocation. *Duration:* Five months. *Movements*, etc.: ? *Operation:* Incision anterior (?), the head was freed by careful dissection and replaced in the socket. Wound sutured. *Difficulties and complications of the operation: ? Complications after the operation: ? Result immediate:* Healing by first intention. *Result remote:* After the removal of the bandage motion was gradually restored. *Remarks ?.*

CASE VII. *1885. Socin.*[140] I. D. O. forward (subcoracoid or axillary), anterior incision (?), arthrotomy, reduction, then resection; result, improvement marked.

Man, aged 46 years. *Diagnosis:* Axillary dislocation. *Duration:* Six weeks. *Movements*, etc. ? *Operation:* Incision (?), arthrotomy and reduction. *Difficulties and complications of the operation: ? Complications after the operation:* The wound opened in the greater portion of its extent and suppurated freely. *Result immediate:* After four weeks there was found in the wound four distinct, completely loose necrotic fragments of bone of considerable size, which evidently belonged to the head of the humerus; resection of the upper extremity of the humerus; there being slight extensive infiltration of pus into the narrow cavity of the bone, hence "evidement" wound left opened and packed; fever followed; passive motion and electricity. *Result remote:* Wound finally healed fully, and the arm could be used pretty well. *Remarks:* The necrosis is noticeable.

CASE VIII. *1885. Schonborn No. 1.*[150] I. D. O. forward (subcoracoid), anterior incision, arthrotomy, reduction, death.

Man, aged ? *Diagnosis:* Subcoracoid dislocation. *Duration:* Chronic. *Movements*, etc.: ? *Operation:* Anterior incision, division of the adhesions with three incisions; at length reduction was effected. *Difficulties and complications of the operation: ? Complications after the operation:* Delirium tremens and purulent bronchitis. *Result immediate:* Death. *Result remote: ? Remarks ?.*

CASE IX. *1885. Schonborn, No. 2.*[151] I. D. O. forward (subcoracoid), anterior incision, arthrotomy, reduction, result fair.

Man, aged ? *Diagnosis:* Subcoracoid dislocation. *Duration:* ? *Movements*, etc.: ? *Operation:* Incision (?), arthrotomy, reduction. *Difficulties and complications of operation: ? Complications after the operation: ? Result immediate: ? Result remote:* The arm could be moved through an arc of 50°; with the simultaneous movement of the

scapula the patient could put his hand on shoulder and back. *Remarks ?.*

Case X. *1886. Pfeiffer.*[152] I. D. O. forward (intracoracoid), anterior incision, fracture of tuberosity, arthrotomy, reduction, result not stated.

Man, aged 42 years. *Diagnosis:* Head of the humerus in Mohrenheim's depression. *Duration:* About three months. *Movements*, etc.: Active motion almost entirely limited, passive slightly freer. Arm cannot be abducted. Rotation impossible and accompanied by pain. No disturbance of sensibility in whole arm; occasional shooting pains in the external cutaneous nerve, and a feeling of formication. Median and radial nerves intact; some dulling of sensation in the ulnar. Circumflex nerve seems to have been squeezed, since at times also there are shooting pains in its course, and also in the long thoracic nerve. *Operation:* Langenbeck's acromio-humeral incision for resection of the head, eight to ten centimetres in length, was made through the deltoid down to the bone. Capsule opened and glenoid cavity freed from it; the capsule had previously spread over it like a cover. Adhesions cut through and head of humerus laid freer. Humerus rotated, abducted, and elevated to break adhesions, and head brought into the cavity. Counter incision made on the under surface of the subscapular muscle. *Difficulties and complications of the operation*: These were due to stretching of the capsule over the glenoid cavity and adhesions, and also to a piece of bone or a cartilage which had been been chopped off from the head of the humerus and was not removed. During manipulation the tendon of the biceps was partially torn from its sheath, and, because of its tendency to slip in a median direction over the lesser tubercle, had to be fastened on the side, with catgut, to the surrounding connective tissue. *Complications after the operation:* None. *Result immediate:* Healed gradually. *Result remote:* Not noted. *Remarks* ?.

Case XI. *1886 (?) Gurlt.*[153] I. D. O. forward (subcoracoid), anterior (?) incision, fracture of greater tuberosity, reduction (?), result, improved.

Sex, ? age, ? *Diagnosis:* ? *Duration:* ? *Movements*, etc.: ? *Operation:* Arthrotomy. *Difficulties and complications of the operation:* The greater tuberosity was split off and caught in between the luxated head and the glenoid cavity at time of the accident, and so reposition was impossible. At operation the cause was found and removed. *Complications after the operation:* ? *Result immediate:* Wound healed soon. *Result remote:* Considerable limitation to normal movements.

CASE XII. *1886. (?) Blasius.*[154] I. D. O. forward (?), anterior incision (?), fracture of lesser tuberosity, arthrotomy, reduction, result, good.

Sex, male, age 17 years. *Diagnosis:* Dislocation of the shoulder, left side. *Duration:* Not given, only spoken of as old. *Movements*, etc.: Nothing said. *Operation:* Arthrotomy, reposition. *Difficulties and complications of the operation:* Small tubercle found broken off and removed. *Complications after operation:* Wound healed after five weeks. *Result immediate:* Nothing said. *Result remote:* Usefulness of the arm soon restored. *Remarks:* None.

CASE XIII. *1886. Maas (from Deus).*[155] I. D. O. forward (subcoracoid), anterior incision, arthrotomy and reduction, death.

Man, aged 42 years. *Diagnosis.* Subcoracoid dislocation. *Duration:* Four months. *Movements*, etc.: ? *Operation:* Incision of Langenbeck (acromio-humeral), ten centimetres long. *Difficulties and complications of the operation.* The capsular ligament was incised, the socket laid bare, and the bands immobilizing the head of the humerus, especially the strong, dense layers of the posterior surface, severed; the head was made free and brought back into its socket. *Complications after the operation:* Suppuration with dissection of the humerus. *Result immediate:* The patient died, evidently of septicæmia, twenty-seven days after operation. *Remarks ?.*

CASE XIV. *1887. Bruns, No 1.*[156] I. D. O. forward (subcoracoid), with fracture of greater tuberosity, anterior incision, arthrotomy, reduction, then resection, result fair.

Man, aged 43 years. *Diagnosis:* Axillary subcoracoid dislocation. *Duration:* Three and a half months. *Movements*, etc.: The arm is in a position of permanent abduction, the olecranon being twelve centimetres from the thorax; abduction was immediately followed by a return of the elbow to its wonted position; the arm could be easily rotated outward; it was longer than the normal by three centimetres. Active motion of the arm could not be performed. The head was wedged tightly in the anterior portion of the axilla; the deltoid convexity was flattened. *Operation:* Incision twelve centimetres, made downward from midway between the acromion and coracoid processes; next the capsular ligament stretched over the socket was dissected away and removed; the thickened capsule and periosteum were now removed from the humerus by means of the periosteotome; the tightly stretched biceps tendon now came into view about two-fingers' breadth

to the outer side of its normal position. *Difficulties and complications of the operation:* The bony mass now exposed was found to be a mass of callus of about the size of a hen's egg, including in its substance the fractured greater tuberosity; glenoid cavity filled with tissue; this was removed. After repeated attempts at reduction the head was finally, with great difficulty, pried into the socket by means of a Loffel spoon used in hip resections; the head was entire with the exception of the missing tuberosity, and had a good covering of cartilage. There remained a large cavity under the pectoralis major in the subcoracoid region, where the head had formerly rested. Drainage backward was provided for; sutures, etc. *Complications after the operation:* At the first dressing, seven days later, retention of pus was discovered, due to obstruction of the drainage course; pressure over the region where the head had been caused the discharge of a large quantity of thick pus. An incision was made directly over this region in order to secure immediate drainage. *Result immediate:* Continued discharge of pus. Two months and a half after the first operation the head was resected; two small sequestra from the humerus were discovered; the socket was surrounded by layers of connective tissue, which were also firmly attached to the head. *Result remote:* Ten days after the resection, etc., the drainage opening had closed. Massage and passive motion could be resorted to. Upon discharge from the hospital, three months after the first operation, abduction carried the olecranon to a distance of twenty centimetres from the axillary line; rotation could be performed through an arc of 22°; elevation forward through the same arc; backward not so far. Passive motion beyond these limits was still painful. *Remarks ?.*

Case XV. *1887. Bruns, No. 2.*[137] I. D. O. forward (subcoracoid), with united fracture of neck, anterior incision, arthrotomy, reduction, later removal of necrotic fragments from head; result fair.

Man, aged 56 years. *Diagnosis:* Subcoracoid luxation. *Duration:* Two years' standing. *Movements*, etc.: Arm abducted; muscular system of the entire arm atrophied, patient could raise his arm to his head only by extraordinary effort and with the help of the sound limb; also posteriorly to the buttock; the middle finger was permanently flexed at the first interphalangeal articulation, but otherwise normal, as were the remaining fingers; the power of the hand was markedly diminished; the sensation was retained except in the second and third fingers, which presented analgesia and a velvety feeling; the radial pulse was smaller on this side. *Operation:* Anterior incision down to the head. *Diffi-*

culties and complications of the operation: The whole of the upper portion of the humerus was overgrown with dense connective tissue layers, so that it was difficult to free the head; the line of a united fracture of the surgical neck was discovered, together with a considerable callous thickening of the fractured greater tuberosity; all this gave to the upper extremity of the humerus a strong resemblance to the upper epiphysis of the femur. This callous growth was reduced to the size of a walnut, and the glenoid cavity cleared out with the sharp spoon; as the cartilaginous covering of the head was intact with the exception of a defective spot on the inner surface, due to the difficulty of prying out the bone, reposition was performed. Drainage-tube in axilla and one on the posterior aspect of the shoulder; catgut sutures, etc. *Complications after the operation:* One week after, the wound had healed all over by primary union; one week later, abundant suppuration through axillary opening, also retention of pus in the lower portion of the healed wound; incision, evacuation. *Result immediate:* Rapid decrease of the suppuration after the incision. *Result remote:* Discharged eight weeks after the operation; still two fistulæ from which a small quantity of thin pus is still being discharged upon any movement of the arm. Movements of rotation, as well as those forward and backward, could be performed both actively and passively, but they were limited in range and accompanied by distinct grating. The velvety feeling is present occasionally, but less frequently observed, and not so marked; the strength of the hand has improved very decidedly. Five months later, the patient says he can continually work at his calling (painter) without difficulty, though pus has been discharged from the still fistulous sinuses ever since; on several occasions splinters of bone had been discharged. The motion of the joint was right, ample and painless; the arm is still rather atrophied; there is a slight crepitation on passive motion; the axis of the humerus is normally directed, but the socket is empty; the probe came upon movable fragments of bone when passed through a fistulous opening in the scar. Incision of the scar showed that, of the entire head, only four or five necrotic fragments remained; these were removed and the granulating cavity curetted. In a few days the patient was discharged with the wound closed. *Remarks ?.*

Case XVI. *1888. Garmany (J. J.).*[158] I. D. O. forward (subcoracoid), anterior incision, arthrotomy, reduction, result good.

Man, aged 39 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Eight weeks. *Movements*, etc: Limited, being restricted to less

than 10°. *Operation:* Incision beginning just external to the coracoid process, and extending downward in the axis of the limb four or five inches; capsule opened; the long head of the biceps muscle was severed; coraco-brachialis and short head of the biceps partially divided; capsule found to consist of exceedingly dense, fibrous tissue, and it was necessary to divide it almost around the entire circumference of the head of the bone; opening made into the glenoid cavity, although the muscles (supraspinatus, infraspinatus and teres minor) were closely applied to it; tissues were separated and the head of the humerus directed through the opening until its articular surface rested against the glenoid cavity; head of bone tended to become dislocated and had to be held in position while the wound was stitched, drainage above and below, Velpeau bandage applied. *Difficulties and complications of the operation:* None. *Complications after the operation:* None. *Result immediate:* In eight days the wound healed; Velpeau bandage retained for a month, when passive motion was commenced. *Result remote:* Two months after the operation he is able to earn a living as a blacksmith; movements scarcely less free than on the other side, strength of muscles has fully returned. *Remarks ?.*

Case XVII. *1889–90. Kocher, No. 7.*[159] I. D. O. forward (intracoracoid), anterior incision, resection, result good.

Man, aged 60 years. *Diagnosis:* Intracoracoid luxation of the right shoulder. *Duration:* Ten months. *Movements*, etc.: Axis of the upper arm turned inward; movements of fingers free; sense of formication in palm of hand. *Operation:* Incision along edge of deltoid; separation of capsule from cavity to which it was firmly adherent; head reduced; drainage and corrosive dressing. *Difficulties and complications of the operation:* Only due to interposition of capsule between head and cavity. *Complications after the operation:* None. *Result immediate: ? Result remote:* One year after the operation patient could use arm for all sorts of work, mowing and chopping. However, there is not the same power in right arm as in left. Muscles, including deltoid, well developed. *Remarks ?.*

Case XVIII. *1890. Vamossy.* I. D. O. forward (subcoracoid), anterior incision, arthrotomy, reduction, result good.

Man, aged 43 years. *Diagnosis:* Subcoracoid luxation of the left shoulder. *Duration:* Five months. *Movements*, etc.: ? *Operation:* Shoulder joint operated by an incision fourteen centimetres long, cutting through skin and deltoid muscle. Incision concave, convexity downward. Coraco brachialis cut through and glenoid cavity freed of

fibrous tissue mass. Head reduced and capsule sewed over it with catgut. Coraco-brachialis united with catgut. *Difficulties and complications of the operation:* Glenoid cavity filled up with shrunken remnants of the capsule. The greater tubercle had to be cut off in order to unite the two ends of the deltoid over the head, when it was reduced. *Complications after the operation:* None. *Result immediate:* Wound healed by first intention. *Result remote:* Movements of the arm at the shoulder-joint, six months after operation, no better when he came into the hospital for operation. *Remarks ?.*

CASE XIX. *1891. Wolfler, No. 1.*[161] I. D. O. forward (subcoracoid), anterior incision, arthrotomy, reduction then resection, result fair.

Man, aged 37 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Six months. *Movements*, etc.: Patient can hardly raise the arm forward and outward to an angle of 45°; shoulder-muscles only partially atrophied; elbow- and wrist-joints free. *Operation:* Incision twelve centimetres long between the deltoid and the great pectoral, until the head of the humerus is met. *Difficulties and complications of the operation:* The head is surrounded by thick fibrous masses, adheres to the surrounding tissues and lies in a new cup; division of the adhesions; the glenoid cavity is filled with tissue, and the head lies in a new capsule; removal of these masses with the sharp spoon; immediately below the head was visible a well-healed fracture; the partially destroyed head is put into its proper place and fixed. *Complications after the operation:* None. *Result immediate:* The wound healed within a few days, but when passive movements commenced a fistula is found at the upper end of the scar which leads to the old cup, no improvement, resection of the head of the humerus by opening first incision; the head is only partially remaining, grayish-yellow in color, irregular in appearance, situated mostly in the old cup; large bone fragments also removed from the glenoid cavity; abscesses, pleuro-pneumonia and pericarditis; new abscesses on the shoulder; decrease of suppuration. *Result remote:* Electricity, exercises; recovery very slow; after two years patient can lift his arm forward and outward to a horizontal position by using the shoulder with it. *Remarks:* At the time of the accident a fracture below the head was diagnosed, but the dislocation was overlooked.

CASE XX *1891. Gould.*[162] I. D. O. forward (subcoracoid), anterior incision, arthrotomy, reduction, result good,

Man, aged 50 years. *Diagnosis:* Humerus dislocated below the

coracoid process, and the whole arm, forearm and hand, œdematous. *Duration:* A little over one month. *Movements*, etc.: Arm paralyzed; pain, vein compressed. *Operation:* An excision down on to the joint along the anterior border of the deltoid muscle, as if for excision of the shoulder, was made. *Difficulties and complications of the operation:* After dividing the subscapularis, supraspinatus, infraspinatus and teres minor tendons completely, with the aid of pulleys fixed to the arm, and a raspatory used as a lever to force out the head of the humerus, succeeded in replacing the head of the bone in the glenoid cavity; considerable force was requisite for this, so much so that a senior colleague advised me to excise the head of the bone. The wound was closed and dressed antiseptically. *Result immediate:* Healed by first intention. Pain was immediately relieved, and never returned; the œdema quickly passed off, and the muscular power was regained. *Result remote:* Three months later adhesions of the shoulder were broken down under gas. Full movement in the joint. *Remarks ?.*

Case XXI. *1891. Cheyne (Watson).*[163] I. D. O. forward (subcoracoid), anterior incision, arthrotomy, reduction, result good.

Man, aged 51 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Four months. *Movements*, etc.: ? *Operation:* Long incision along the anterior edge of the deltoid; defined it well and pulled it outward; the coraco-brachial, stretched on the head, was divided; also the subscapular at its insertion; division of fibrous bands and part of the great pectoral; head at length replaced in the glenoid cavity. *Difficulties and complications of the operation:* None. *Complications after the operation.:* None. *Result immediate:* Healed by first intetion; passive motion began the next day. *Result remote:* Nine months afterward the head was still in position, but seemed slightly further forward; patient has quite a useful arm, and was able do his work as a polisher, but he could not quite raise it to a right angle without moving the scapula. *Remarks:* None.

Case XXII. *1892. Schede, No. 1.*[164] I. D. O. forward (subclavicular), anterior incision, arthrotomy, reduction, result improved.

Man, aged 31 years. *Diagnosis:* Subclavicular dislocation of the left shoulder. *Duration:* Thirteen weeks. *Movements*, etc.: Active movements very slight; deltoid paralyzed; passive motions also much limited. *Operation:* Incision along outer edge of dislocated head; muscles cut through, and also tendon of biceps; glenoid cavity freed of fibrous mass; head reduced. *Difficulties and complications of the operation:* Capsule was enormously thickened and tendon of the biceps

luxated and shortened; glenoid cavity seemed to have disappeared, and was completely obliterated by very firm, thick cicatricial fibrous mass; the extirpation of this was difficult and bloody; attempt failed to reunite tendon of the biceps Wound sewed up and closed without drainage. *Complications after the operation:* None. *Result immediate:* Wound healed by primary union. *Result remote:* Ten weeks after operation passive motion was almost normal in extent; though there was crepitation in the joint. Use of forearm and hand was very free and strong; at shoulder all movements with the exception of elevation were good. Five months later, movements both active and passive were still better than in October; except for elevation, the deltoid was useless, and did not react to electricity. *Remarks ?.*

Case XXIII. *1892. Schede, No. 2.*[165] I. D. O. forward (subcoracoid), anterior incision, arthrotomy, reduction, apoplexy, death.

Female, aged 60 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Eight weeks. *Movements*, etc.: Arm much swollen and patient suffered severely with pain in the arm. *Operation:* Incision fifteen centimetres long, extending downward, from inner edge of acromion; capsule opened; incision into pocket where head had lain and drain from here backward under head through a counter incision; head reduced. *Difficulties and complications of the operation:* Glenoid cavity filled with fibrous tissue, the greater tubercle was found broken off, no callus at point of fracture. Capsule very much thickened, and there had been much hemorrhage into it. It had to be freed for some distance along the humerus. The glenoid cavity was filled with abundant granulating remains of the capsule, but its cartilage was well retained. *Complications after the operation:* Immediately on the narcosis, followed stupor, which became deeper and more complete all the time, and was finally associated with complete paralysis of the left side; six days later pneumonia developed and the patient died. *Remarks:* Patient had had an attack of epilepsy three months before accident. The dislocation was not recognized at first, and no attempt at reduction was made till patient entered the hospital.

Case XXIV. *1893. Cotterill (J. M.), No. 1.*[166] I. D. O. forward (subcoracoid), anterior incision, reduction, result fair.

Male, aged 38 years. *Diagnosis:* Forward subcoracoid dislocation. *Duration:* Four months. *Movements*, etc.: Great impairment of movements. *Operation:* An incision about five inches in length was made over the coracoid in the interval between the deltoid and pectoralis major. The head of the bone was then seen lying below the coracoid

process, in direct contact with the large vessels and nerves and mostly covered by the pectoralis minor. This structure being divided, the head was carefully separated from its adhesions to the vessels and nerves, and reduction was attempted. *Difficulties and complications of the operation:* It was then found necessary to divide the tendons of the infraspinatus and supraspinatus muscles, also the long head of the biceps, before the bone could be brought opposite the glenoid cavity. A further difficulty was then encountered, for the glenoid cavity was found to be partially filled up with fibrous tissue, and the deltoid had acquired such adhesions by its under surface to this fibrous tissue that great force had to be employed to open up the glenoid cavity. The head of the bone was then replaced in proper position and a posterior counter opening made. *Complications after the operation:* None. *Result immediate:* Suppuration ensued, but the wound healed well eventually. *Result remote:* Patient left the hospital in August (came in April), with good movement in joint, less atrophy of the muscles, and no numbness or pain referable to pressure on the nerves; four months after leaving the hospital, motions backward were perfect, forward deficient; angle from the side 60°. Able to work as pointsman. *Remarks* ?.

Case XXV. *1893. Cotterill, No. 2.*[167] I. D. O. forward (subcoracoid), anterior incision, with fracture of the glenoid cavity, arthrotomy, reduction, result good.

Man, aged 40 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Over one month. *Movements*, etc. ? *Operation:* Anterior incision. *Difficulties and complications of the operation:* Separation of the part of the anterior and lower edge of the glenoid; this cavity was found partly filled with new material, though not so completely occluded as in Case I. Adhesions being divided, the head was reduced again with considerable difficulty into the glenoid cavity. *Complications after the operation:* Suppuration. *Result immediate:* The patient was discharged in three months, with wound firmly healed and great improvement in the condition of the arm. *Result remote:* Four months after leaving the hospital wound firmly healed, no pain or numbness; muscular development normal, rotation fair, elevation of arm from side almost to right angle. Patient able to do his work as a quarryman; steady improvement. *Remarks:* ? *Reference:* Same as Case I.

Case XXVI. *1893. Severeano.* I. D. O. forward (subcoracoid), transverse anterior and vertical incision, arthrotomy, reduction, result good.

Man, aged 38 years. *Diagnosis:* Luxation ?. *Duration:* One hundred and three days. *Movements*, etc.: ? *Operation:* Incision, antero-posterior, ten centimetres long, along the summit of the shoulder, and on its superior surface, two centimetres from the acromion, approaching apophysis in front and behind. Then the bone was cut through with a saw (?). At the anterior extremity of the incision a second was made, parallel to the axis of the arm, running alongside of the cephalic vein for a distance of eight centimetres. Capsule opened through its whole extent. Cicatrical tissue binding the head was cut away. Head reduced. Osseous sutures with silver wire; glenoid cavity was free, the capsule was whole. *Difficulties and complications of the operation:* Head of the humerus was bound down in its faulty position by many and strong adhesions. Hæmostasis by means of a rubber tube over the shoulder and under the axilla. *Complications after the operation:* A few drops of pus from the sutures. *Result immediate:* Wounds healed by first intention except for those few drops of pus, which ceased when the sutures were removed. *Result remote:* Twenty-two days after operation the patient could perform alone slight movements in elevation, adduction and abduction. *Remarks* ?.

Case XXVII. *1893. Pollosson, No. 1.*[169] I. D. O. forward (subcoracoid), anterior incision, arthrotomy, reduction, result good.

Man, aged 55 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Six months. *Movements*, etc.: ? *Operation.* Interdeltoido-pectoral incision; incision of capsule on same line; head easily reduced by traction and torsion. *Difficulties and complications of the operation:* None. *Complications after the operation:* None. *Result immediate:* Primary union. *Result remote:* Functional result almost perfect. *Remarks* ?.

Case XXVIII. *1893. Pollosson, No. 2.*[170] I. D. O. forward (subcoracoid), anterior incision, arthrotomy, reduction, result good.

Man, aged 52 years. *Diagnosis:* Subcoracoid luxation. *Duration:* Six weeks. *Movements*, etc.: ? *Operation:* Interdeltoido-pectoral incision, head reduced by traction and torsion. *Difficulties and complications of the operation:* None. *Complications after the operation:* None. *Result immediate:* Primary union. *Result remote:* At the end of three weeks head in place, no anchylosis, final result good. *Remarks* ?.

Case XXIX. *1893. Pollosson, No.* 3.[171] I. D. O. forward (subcoracoid), anterior incision, arthrotomy, reduction, result good.

Man, young. *Diagnosis:* Subcoracoid dislocation. *Duration:* ?

Movements, etc.: ? *Operation:* Anterior incision, arthrotomy, reduction. *Difficulties and complications of the operation:* None. *Complications after the operation:* None. *Result immediate:* Primary union. *Result remote:* Good. *Remarks* ?.

CASE XXX. *1893. Pollosson No. 4.*[172] I. D. O. forward (subcoracoid), anterior incision, arthrotomy, reduction, later resection, result not stated.

Woman, aged 60 years. *Diagnosis:* Subcoracoid (?) dislocation. *Duration:* Three months. *Movements*, etc.: ? *Operation:* First anterior incision; second transverse subacromial involving the anterior third of the deltoid. *Difficulties and complications of the operation:* None. *Complications after the operation:* Suppuration. *Result immediate:* Suppuration; head became necrotic and had to be resected. *Result remote:* Not stated. *Remarks* ?.

CASE XXXI. *1893. Pollosson No.* 5.[173] I. D. O. forward (subcoracoid), anterior incision, arthrotomy, reduction, sepsis, death.

Man, aged 64 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Two months. *Movements*, etc.: ? *Operation:* Two incisions as in Case IV. *Difficulties and complications of the operation:* Some venous hemorrhage from possible injury to the axillary vein; reduction very tedious. *Complications after the operation:* Suppuration. *Result immediate:* Sepsis. *Result remote:* Death from sepsis. *Remarks* ?.

CASE XXXII. *1893. Cheyne (Watson).*[174] I. D. O. forward (subcoracoid), anterior incision, arthrotomy and reduction, result good.

Woman, aged 18 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Nine months. *Movements*, etc.: ? *Operation:* Long incision from coracoid process downward between the pectoral and deltoid muscles; the inner fibres of the deltoid were detached from the humerus so as to get a better view; the long head of the biceps, which was in the way, was temporarily removed from its groove; the greater portion of the subscapular divided at its insertion and some fibres of the supraspinous; head of bone then easily replaced after clearing out the glenoid cavity; tendon of the biceps put back in its groove. *Difficulties and complications of the operation:* None. *Complications after the operation:* None. *Result immediate:* Healing by first intention; passive motion begun on the twentieth day; full range is easily obtained under an anæsthetic. *Result remote:* Four months after operation can raise the arm easily to do back hair, and this movement was improving, other movements quite good. *Remarks:* None.

CASE XXXIII. *1893. Poncet.*[175] I. D. O. forward (subcoracoid), anterior incision, arthrotomy, reduction, result fair.

Man, aged ? years. *Diagnosis:* Subcoracoid dislocation. *Duration:* ? *Movements*, etc.: Compression of brachial plexus, rapid atrophy of the muscles of the arm. *Operation:* Incision (?), new capsule thick and resistant; incision of this capsule; clearing of the tendon of the biceps and coraco-brachial; easy reduction of the head in the healthy glenoid cavity. *Difficulties and complications of the operation:* None. *Complications after the operation*: None. *Result immediate:* Rapid healing. *Result remote:* Five months afterward the patient can carry a bucket of water; the head, however, had slipped slightly below the glenoid cavity; the atrophy of the deltoid persists; the other muscles have recovered their size. *Remarks:* None.

CASE XXXIV. *1893. MacCormac (Sir W.).*[176] I. D. O. forward (subcoracoid), with fracture of the tuberosity, anterior incision, arthrotomy, reduction, later resection, result good.

Man, aged 40 years. *Diagnosis:* Subcoracoid dislocation, with fracture of the greater tuberosity. *Duration:* Three months. *Movements*, etc. ? *Operation:* Incision interdeltoido-pectoral; arthrotomy, reduction. *Difficulties and complications of the operation:* The greater tuberosity had been fractured and a mass of callus had formed; also the anterior third of the glenoid cavity had been detached from the balance; the posterior portion of the cup was filled with fibrous tissue and the old capsule; the cavity was cleaned and the head reduced; the cartilage of the head of the cup seemed normal. *Complications after the operation:* Suppuration. *Result immediate:* The pain and suppuration persisting, the head is resected through the anatomical neck. *Result remote:* Perfect cure (no details given). *Remarks* ?.

CASE XXXV. *1895. Souchon (Edmond).*[177] I. D. O. forward (subcoracoid), anterior incision, arthrotomy and reduction, shedding of cartilage, result death.

Man, aged 52 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Three months. *Movements*, etc.: Paralysis of all the muscles of the shoulder and arm; he can move the forearm some and flex the fingers; complete loss of sensation, except on the posterior aspect of the arm; hand œdematous. *Operation:* Anterior incision near the anterior border of the deltoid; incision through the capsule; its walls are hard and about one-quarter of an inch thick; incision around the head until it is freed; head normal, also glenoid cavity; reduction accomplished with a little force; drainage-tube behind. *Difficulties*

and complications of the operation: None. *Complications after the operation:* Suppuration. *Result immediate:* Relief from pain; disappearance of the œdema. *Result remote:* Suppuration considerable; at two different times pieces of cartilage of the head were removed from the wound while irrigating it. There is a little more motion; seven weeks after the operation all the wounds were closed; patient nourishes badly, grows weaker and finally dies; his peritoneum presents miliary tubercles in the region of the left iliac fossa. The posterior part of the capsule has folded under and was between the head and glenoid cavity. *Remarks:* None.

CASE XXXVI. *1895. Reboul (J.).*[178] I. D. O. forward (subcoracoid) anterior incision, arthrotomy, reduction, result good.

Woman, aged 42 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Fifty-four days. *Movements*, etc. ? *Operation.* Double incision (transverse and longitudinal); then arthrotomy and reduction. *Difficulties and complications of the operation:* Capsule adherent in front of glenoid cavity and head; also on posterior part; thick fibrous bands bound the head down; tendon of biceps moved out of the way, cup cleared; the head is made to rest by the posterior superior portion of the anatomical neck on the antero-inferior edge of the glenoid cavity; by the combined movements of abduction and rotation, with pressure upon the head with the fingers and with a periosteotome as a lever, the head is reduced, but after much difficulty; the dissection in front, near the vessels, long and tedious; capsule restored, suture of sheath of tendon of the biceps. *Complications after the operation:* None. *Result immediate:* Primary union. *Result remote:* Good. *Remarks:* None.

CASE XXXVII. *1897. Tuttle (J. P.).*[179] I. D. O. forward (subclavicular), anterior incision, reduction, result good.

Man, aged ? years. *Diagnosis:* Subclavicular dislocation. *Duration:* Two months. *Movements*, etc.: Had no use of the arm whatever. *Operation:* Attempt at reduction under ether, but as soon as the head was brought nearly within the glenoid cavity something would act so as to pull it back to its former position. Cut down on the head, found that the head of the bone had passed around the coraco-brachial ligament in such a manner that when it was brought nearly within the cavity the ligament would jerk it out like the string of a bow; reduction was easily effected in replacing the ligament. *Complications after the operation.* ? *Result immediate.* ? *Result remote:* Has good use of his arm. *Remarks* ?.

Case XXXVIII. *1897. Parmenter (John).*[180] I. D. O. forward (subcoracoid), anterior incision, reduction, improved.

Woman, aged 40 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Two and a half months. *Movements*, etc. ? *Operation:* Anterior incision and reduction. *Difficulties and complications of the operation:* After considerable difficulty the tendons of the subscapular and supra- and infraspinatus having been divided, the head was easily returned to the socket; the cup seemed nearly normal. *Complications after the operation:* None. *Result immediate:* Primary union. *Result remote:* Left the hospital much improved and returned to farm-work which involved heavy lifting; this was soon followed by pain, disability, swelling, crackling, and sensation of slipping in and out; arm cannot be raised without help. Later, patient fell and struck elbow; something cracked, pain and disability suddenly ceased, so that now the hand can be carried anywhere in all directions. *Remarks.* It would seem as though the patient by returning to work too soon produced at least a partial dislocation of the joint, that this became more or less fixed in this normal position until the accident, which caused reduction of the partial dislocation. It would seem, therefore, that too early use of the part, especially heavy lifting, should not be indulged in by patients on whom free division of supporting structures had to be performed.

Case XXXIX. *1897. Ransohoff (Joseph).*[181] I. D. O. forward (subclavicular), anterior incision, arthrotomy, reduction, result good.

Man, aged 21 years. *Diagnosis:* Subclavicular dislocation. *Duration:* Three and a half months. *Movements*, etc.: Muscles of limb considerably atrophied; abduction of elbow from side of the body impossible beyond an angle of 30°; unable to get his hand to the back. *Operation:* Incision about six inches in length from over the coracoid process downward and outward on the line of the humerus and between the fibres of the deltoid. *Difficulties and complications of the operation:* By means of elevation and cutting with the scissors the adhesions surrounding the head were broken off and it was denuded, but with great difficulty; cartilage of the head unchanged, glenoid fossa filled in its lower part with exuberant granulations, which were removed with a sharp spoon; they were tough and bled freely; the central part of the cup was crossed with normal cartilage, reduction failed until capsule was divided in its entire circumference and the humeral neck exposed to the lower borders of the tuberosities; reduction easily maintained. *Complications after the operation:* Slight fever. *Result immediate:*

Primary union. *Result remote:* Functions very much improved; rotation fairly practicable, but arm cannot be elevated from the side of the body at more than an angle of about 45°; atrophy of the muscles has not been improved. *Remarks* ?.

HISTORIES OF I. D. O. AND FORWARD, TREATED THROUGH AN ANTERIOR INCISION BY RESECTION.

Case XL. *1858. Langenbeck.*[182] I. D. O. forward (subcoracoid, with old fracture of greater tuberosity), anterior incision, resection, improved.

Man, vigorous, aged 41 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* One year. *Movements*, etc. ? *Operation:* Anterior incision (?), resection. *Difficulties and complications of the operation:* It was found that there had been a fracture of the greater tuberosity with displacement, which had united. *Complications after the operation:* Erysipelas and copoius suppuration. *Result immediate:* After three months the wound finally healed. *Result remote:* Four years later Luckie observed a displacement of the humerus under the acromion process; the arm could not be lifted to the horizontal plane; the movements of the forearm and hand were strong and free. *Remarks:* There was at first a fracture of the arm, and after union had taken place a dislocation of the shoulder, probably dating back to the same injury, was observed; attempts at reduction were unsuccessful.

Case XLI. *1862. Langenbeck.*[183] I. D. O. forward (axillary or subcoracoid), with fracture of lesser tuberosity, anterior incision, resection, death.

Man, aged 46 years. *Diagnosis:* Axillary (subcoracoid ?) dislocation; examination revealed also the presence of a small piece of bone separate from the humerus under the coracoid process; the fragment did not move with the humerus, which proved to be a fracture of the lesser tuberosity. *Duration:* Three months. *Movements*, etc.: ? *Operation:* Antero-interne incision and resection. *Difficulties and complications of the operation:* Great difficulty in removing the head, owing to strong adhesions and to the fracture of the lesser tuberosity. *Complications after the operation:* Pyæmia. *Result immediate:* Patient died on the eleventh day. *Remarks* ?.

Case XLII. *1868. Paget.*[184] I. D. O. forward (subcoracoid), with old fracture of the surgical neck; semilunar incision or median incision, resection, result not stated.

Man, age, adult. *Diagnosis:* Subcoracoid dislocation (head of the humerus forward), united fracture as well as dislocation. *Duration:* Twelve months. *Movements*, etc.: Humerus quite immovable. *Operation:* Semilunar incision from near the outer end of the clavicle to the tip of the acromion, and down the arm an inch or two. *Difficulties and complications of the operation:* Operation long and tedious; great difficulty from the bony connections, which stretched not only from the head, but also from the shaft of the humerus to the glenoid cavity and the neck of the scapula; there must have been fracture about the neck extending down the bone, a large amount of callus helping to fix the head of the bone firmly in its unnatural position. *Complications after the operation:* Not stated. *Result immediate:* Not stated. *Result remote:* Not stated. *Remarks* ?.

CASE XLIII. *1869. Warren.*[185] I. D. O. forward (subcoracoid), V-incision, resection, good result.

Female, aged 50 years. *Diagnosis;* Subcoracoid dislocation; head of the humerus pressing against the brachial flexus of nerves, some of the trunks of which seemed to have been dragged forward by the bone. *Duration:* One year. *Movements*, etc.: Limb fixed useless; excruciating pain. *Operation:* The V-shaped incision of Sabatier, as modified by Gayrand, was made in the premises; preservation of tendon of biceps; humerus was divided through the surgical neck, its head removed and the excised shaft carried back to the glenoid cavity. *Difficulties and complications of the operation:* None. *Complications after the operation:* None. *Result immediate:* Wound healed rapidly and well. *Result remote:* Some months later the humerus was well up toward the glenoid cavity, action of the deltoid in a great measure lost, arm could be elevated to head; considerable latitude of motion had been restored; patient could sew and feed herself. *Remarks* ?.

CASE XLIV. *1872. Reid.*[186] I. D. O. forward (axillary), with fracture of the greater tuberosity; anterior incision, resection, result good.

Man, aged 20 years. *Diagnosis:* Axillary dislocation; the arm stood out from the body; abduction was impossible; forward and backward movements were also very limited, so that the arm was useless; patient could seize and press with his hands. *Duration:* Two months. *Movements*, etc.: Feeling of numbness in the fingers. *Operation:* Incision over the head, six or seven centimetres in length, about a thumb's breadth from the outside of the coracoid process; after incision of the remnants of capsule and of the muscular insertions, the

head was easily isolated; the bone was sawed through at the surgical neck. *Difficulties and complications of the operation:* On the resected head was found the fractured greater tuberosity driven at an abnormal angle into the spongy substance of the head. *Complications after the operation:* Suppuration. *Result immediate:* Healed in four weeks. *Result remote:* After two months, movements of the arm were pretty fair; it could be raised to a right angle; the muscles of the arm were well developed; shortness of three centimetres; full strength in the hands and fingers; numbness gone. *Remarks* ?.

Case XLV. *1874. Thiersch.*[187] I. D. O. forward (intracoracoid); fracture of the humerus in middle in attempting to reduce before cutting; anterior incision, (?) resection, result improved.

Woman, aged 48 years. *Diagnosis:* Intracoracoid dislocation (inward and forward). *Duration:* Six weeks. *Movements*, etc. ? *Operation:* Attempt to reduce led to fracture of the humerus in its middle. *Difficulties and complications of the operation:* The attempt to free the exposed head and reduce it was thwarted by the short, dense adventitious growths, which could not be divided without jeopardizing the axillary nerves and vessels stretched over the head, hence resection. *Complications after the operation:* Suppuration. *Result immediate:* Very slow healing; fracture had united in the third week. *Result remote:* At the time of discharge there was moderate usefulness of the arm. *Remarks* ?.

Case XLVI. *1875. Langenbeck.*[188] I. D. O. forward (axillary, *i. e.*, subcoracoid), with old fracture of greater tuberosity; anterior incision (?), improved slightly.

Man, aged 45 years. *Diagnosis:* Axillary dislocation. *Duration:* Five months. *Movements*, etc.: Very limited in all directions, symptoms of pressure on the brachial plexus. *Operation:* ? *Difficulties and complications of the operation:* The greater tuberosity was found broken off. *Complications after the operation:* None. *Result immediate:* The wound healed by primary union (?) six weeks after the operation. *Result remote:* Although the muscles reacted well to electricity, the usefulness of the arm was found but slighty improved. *Remarks* ?.

Case XLVII. *1875. Annandale*[189] I. D. O. forward (subclavicular), anterior incision, ligation of the axillary artery, resection of head piecemeal, death.

Woman, 60 years. *Diagnosis:* Subclavicular dislocation. *Duration:* Six weeks. *Movements*, etc.: Much pain. *Operation:* Incision along the anterior portion of the deltoid. *Difficulties and complications*

of the operation: Impossibility to free the head and replace it in its socket; division of the bone at the surgical neck and removal of head piecemeal, it was firmly adherent to the ribs; wounding of the posterior circumflex; it was tied, but the ligation cut through, owing to endoarteritis, and the stump of the vessel being only an eighth of an inch long, the axillary artery was tied above and below. *Complications after the operation:* Gangrene followed. *Result immediate:* Death on third day. *Remarks ?.*

Case XLVIII. *1876. Israel.*[190] I. D. O. forward (subcoracoid), anterior incision (?), resection, secondary hemorrhage; death.

Man, aged 60 years. *Diagnosis:* Subcoracoid dislocation. *Duration: ? Movements*, etc.: The dislocation was accompanied by complete anæsthesia and paralysis of the parts supplied by the ulnar nerve; the whole arm feeling like a dead weight. *Operation:* Resection. *Difficulties and complications of the operation: ? Complications after the operation:* A secondary hemorrhage occurred. *Result immediate:* Patient died from the hemorrhage.

Case XLIX. *1876. Weinlechner.*[191] I. D. O. forward (intracoracoid), anterior incision, resection, improved.

Female, aged 76 years. *Diagnosis:* Luxation of right shoulder inward from the coracoid process. *Duration:* Six months. *Movements*, etc.: Loss of power in arm, associated with severe pain radiating into the hand. *Operation:* Long incision through the deltoid muscle and breaking up of adhesions about the glenoid cavity; resection of the head, another incision for drainage at lowest point of the axilla, drainage-tube, etc. *Difficulties and complications of the operation:* Only due to adhesions on anterior surface of the shoulder-blade close to the edge of the glenoid cavity. *Complications after the operation:* Some suppuration; six weeks after the operation slight suppuration of arm. *Result immediate:* Wound healed slowly; after operation the end of the resected humerus was two centimetres below the coracoid process. *Result remote:* Passive movements were limited in all directions; the arm can hardly be raised to the chin, or brought beyond the right trochanter, abduction only to a right angle; no more pain. *Remarks ?.*

Case L. *1878. Reid.*[192] I. D. O. forward (subcoracoid), anterior incision, resection, result good.

Man, aged 34 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Eighteen months. *Movements*, etc.: Movements of shoulder-joint very limited; in active motion the arm could be brought forward

but little; outward not at all, backward a little; passive motion could bring the arm forward to an angle of 45°; abduction separated it by two centimetres; the backward movement was also very limited; on free manipulation, grating and snapping could be plainly detected; the arm was three centimetres longer than the normal; it appeared a little cyanosed and cooler; no disturbance of sensation. *Operation:* Incision two centimetres over the luxated head through skin and muscle; incision of the capsule, separation of muscles and tendons close to the bone; division of the bone at the surgical neck with a chain saw. Wound sutured, and upper extremity bandaged and fixed to the limb with the forearm fixed at right angles. *Difficulties and complications of the operation: ? Complications after the operation: ? Result immediate:* Wound healed in ten days. A few days later many varieties of gymnastics were practised. *Result remote:* Four and a half months later passive motion can be practised. *Remarks ?.*

CASE LI. *1880. Reid.*[193] I. D. O. forward, double (subclavicular) incision, resection on both sides, result very good.

Man, aged 53 years. *Diagnosis:* Double subclavicular dislocation. *Duration:* Eight months. *Movements*, etc.: Complete uselessness of both upper extremities; the patient was not able to eat or drink alone; when lying he could not sit up or turn. OPERATION ON RIGHT SIDE: Resection of right head was first performed; nearly three centimetres below the surgical (?) neck. *Difficulties and complications of the operation:* The resection was effected with much difficulty. *Complications after the operation:* The healing was suppurative. OPERATION PERFORMED ON LEFT SIDE: Two and a half months after the first resection the second was performed. *Difficulties and complications of the operation: ? Complications after the operation:* Suppuration. *Result immediate:* Healing tedious, discharge of sequestra, gymnatic exercises. *Result remote:* Seven months after the first operation the patient could reach the forehead with his hands, could eat without help; rotation could be performed in some slight degree; abduction was limited. Six years and a half later the man is employed as a maltster in a brewery, enjoys splendid use of his arms. In weighing the sacks, he could lift a hundred weight one-half meter from the floor upon the scales; he needed no help in dressing, combing, eating, etc. The movements of the humerus, abduction, forward and backward movements, and specially rotation, were much more free and strong on the left than on the right arm; the muscular development of the left arm was below normal, but in a much less atrophic state than that of the

right. The upper extremity of the resected humerus was rounded and somewhat globular on the left; in the glenoid cavity on either side. *Remarks ?.*

CASE LII. *1880. Marsh (Howard).*[194] I. D. O. forward (?), resection. Result ?.

Man, aged ? years. *Diagnosis: ? Duration:* Old. *Movements*, etc.: Atrophy of muscles; enduring agonizing pain. *Operation:* First rupture of the adhesions was tied without success; then nerve-stretching, but with equally poor success; finally, resection performed. *Difficulties and complications of the operation:* The nerve-stretching was done with much difficulty. *Complications after the operation:* ? *Result immediate:* Neuralgia continued. *Result remote ?.*

CASE LIII. *1881. Hofmokl.*[195] I. D. O. forward (subcoracoid), incision (?), resection, result good.

Man, aged 31 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Three months. *Movements*, etc.: Head of the humerus joined to capsule by malformation, anchylosed; every movement of the arm is attended by motion of the scapula. *Operation:* Incision, Roberts' operation, resection of the head. *Difficulties and complications of the operation:* The head was found to be fixed to the glenoid cavity by strong adhesions, which were removed subperiosteally as much as possible; severe parenchymatous hemorrhage; Lister's dressing. *Complications after the operation:* The first three days the bandage had to be removed daily on account of the hemorrhage. *Result immediate:* Primary union on the fifth day; gymnastics, electricity, etc. *Result remote:* Three months after the operation the patient can execute all active movements with the arm, both in the shoulder and in the elbow; he could lift moderately heavy objects, he could also write, which was impossible before the operation. *Remarks ?.*

CASE LIV. *1882. Schonborn.*[196]. I. D. O. forward (subcoracoid), anterior incision (?), resection; result improved.

Girl, young. *Diagnosis:* Forward, subcoracoid dislocation. *Duration:* Twenty weeks. *Movements*, etc.: ?. *Operation:* Anterior incision (?), resection. *Difficulties and complications of the operation: Complications after the operation:* ? *Result immediate: Result remote:* Eight months later could put her hand on the opposite shoulder; movements backward very limited, and on application of massage and electricity the muscles did not grow any stronger. *Remarks* ?.

CASE LV. *1883. Book.*[197] I. D. O. forward (subcoracoid), incomplete, anterior incision (?), resection, result good.

Female, aged 26 years. *Diagnosis:* Incomplete subcoracoid dislocation. *Duration:* Four months. *Movements*, etc.: Disuse of arm and great pain. *Operation:* Incision (?), the head of the bone is resting on the anterior rim of the glenoid cavity; it was unchanged. *Difficulties and complications of operation:* None. *Complications after the operation: ? Result immediate: ? Result remote:* Marked improvement. *Remarks* ?.

Case LVI. *1886. Pfeiffer.*[198] Forward, with fracture of the greater tuberosity, anterior incision (?), resection or reduction (?); result good.

Man, aged ? *Diagnosis:* ? *Duration:* ? *Movements*, etc.: ? *Operation:* Incision (?), arthrotomy; reduction (?) or resection ?. *Difficulties and complications of the operation:* The greater tuberosity was broken off and wedged between the dislocated head and the joint cavity; it was removed. *Complications after the operation: ? Result immediate:* ? Healing readily. *Remarks ?.*

Case LVII. *1887. Bellamy.*[199] I. D. O. forward (?) (subcoracoid), chronic arthritis of pseudo-joint; resection, result good.

Male, aged 16 years. *Diagnosis:* Old standing dislocation. *Duration:* Three years. *Movements*, etc. Arthritis and suppuration due to manipulations to replace; four sinuses have formed. *Operation:* Incision anterior (?), making use of the existing sinuses; resection of the head; long head of the biceps removed with the head, as it was too much implicated to be saved; glenoid cup scraped with sharp spoon; also the sinuses. *Difficulties and complications of the operation: ? Complications after the operation:* Suppuration. *Result immediate:* Short suppuration. *Result remote:* Good. *Remarks ?.*

Case LVIII. *1887. Billroth.*[200] I. D. O. forward (?), anterior incision, resection, result improved.

Man, aged — years. *Diagnosis:* ? *Duration:* ? *Movements*, etc.: There was complete paralysis of arm. *Operation:* Incision, (?) typical resection. *Difficulties and complications of the operation: ? Complications after the operation: ? Result immediate: ? Result remote:* Considerable improvement in the functions of the arm, although, as might be expected, there was not complete cure of the paralysis. *Remarks ?.*

Case LIX. *1888. Ollier.*[201] I. D. O. forward (intracoracoid), anterior incision, resection, result good.

Man, aged 27 years. *Diagnosis:* Intracoracoid dislocation. *Duration:* Five months. *Movements*, etc.: They cause much pain, pressure also causes pain; owing to this arthritis all interference is delayed

until it is allayed. *Operation:* Longitudinal incision along the anterior border of the deltoid; in the interdeltoido-pectoral grooves; head found under the coracoid process; after cutting the fibrous bands felt by the fingers an attempt is made to reduce the dislocation, but failed; long incision of the capsule; the coracoid process had produced a deep indentation on the head; head was cleared subperiosteally and forty-three millimetres of the head and shaft were removed. Glenoid cavity mashed by fibrous tissues (capsular buttonhole) gathered upon themselves; incision through the mass; cup lined with its cartilage of a white-yellow aspect, fibrous, so thickened in the centre as to fill the cavity and transform it into a plane surface almost convex. *Difficulties and complications of the operation:* The extent of the adhesions is such that it would require so very extensive dissection to reduce that it was thought best to resect; it required much dissection to reduce the sawed extremity of the bone; there is some difficulty in keeping the extremity of the sectioned humerus in the glenoid cavity, as it is drawn inward by the abductor muscles retracted so long by the nearing of their attachments; the extremity has a constant tendency to go under the coracoid process, the elbow must be brought on the chest and raised to keep the extremity in the cup; posterior drainage. *Complications after the operation:* None. *Result immediate:* Process of repair uninterrupted; on the fifteenth day passive motion was begun. *Result remote:* A strong and mobile joint was formed; on leaving the hospital the patient could separate elbow fifteen centimetres from body, and his arm was so strong he wanted to resume work. He could easily carry his hand back of his thigh of the sound side and execute the movements of his profession (harness-making). Seen ten months later, the head of the humerus is well fixed against the glenoid cavity, and there is no tendency to luxation when the patient separates his arm from his body. The top of the humerus is higher than the coracoid process. Passive movements are not more extensive than the active. His arms can be extended in the form of a cross, but the one operated upon stands somewhat forward of the other. Movements of abduction are limited by the formation of fibrous tissue purposely allowed to organize after the operation. The deltoid contracts energetically, but is still atrophied. Movements of rotation inward are good, but limited outward. Elevation of arm is good. *Remarks:* None.

Case LX. *1888. Shield.*[502] I. D. O. forward (subcoracoid), resection; result good.

Man, aged 45 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Twelve weeks. *Movements*, etc.: Marked ulnar nerve paralysis, both motor and sensory; also of the median nerve, but not as much; radial pulse much diminished; complete loss of power of the hand. *Operation:* Anterior incision. *Difficulties and complications of the operation:* The head was found at a great depth surrounded by fibrous adhesions; it was finally cleared and drawn out and divided from the shaft at the level of the anatomical neck. *Complications after the operation:* ? *Result immediate:* Patient made a good and uninterrupted recovery; the radial pulse resumed its ordinary strength immediately after the operation; three days after the operation the sensory paralysis of the median and ulnar nerve had almost disappeared. *Result remote:* Twelve weeks after the operation, after the use of massage and galvanism, the atrophied muscles had in part been restored, the muscles of the shoulder were satisfactory, the arm and hand can be used freely in the exercise of his vocation (hotel tapster). *Remarks* ?.

CASE LXI. *1889. Finckh.*[203] I. D. O. forward (subcoracoid), with united fracture of greater tuberosity, anterior incision, resection, result good.

Man, aged 46 years. *Diagnosis:* Axillary (subcoracoid), luxation of right shoulder. *Duration:* Three months. *Movements*, etc.: ? *Operation:* Resection of head of the humerus. *Difficulties and complications of the operation:* During operation there was found a piece of bone, about the size of a hen's egg, which, surrounded by a covering of thick connective tissue, was attached to the anterior surface of the shaft of the humerus below the surgical neck; it was the greater tubercle which had been broken off, and which by a callous growth was firmly attached to the humerus. The tubercle was removed; the head of the humerus was dislocated from its newly formed cavity and its surface was found intact. The glenoid cavity was still covered by well-preserved cartilage. The head of the humerus was resected at the surgical neck and the shaft pressed into the glenoid cavity. The wound closed. *Complications after the operation:* ? *Result immediate:* Healing by first intention. *Result remote:* Two and a half weeks after the operation the patient began active movements, which soon became free, with the exception of outward rotation, which of all the movements was carried out worst. *Remarks:* Three attempts at reduction had been made unsuccessfully before operation.

CASE LXII. *1889. Fenger.*[204] I. D. O. forward (intracoracoid), anterior incision, resection, result fair.

Man, aged 56 years. *Diagnosis:* Old dislocation of the humerus. *Duration:* Nine months. *Movements*, etc.: There was inability to rotate the arm, loss of motion, and semiflexion of the digits due to paresis. *Operation:* After an unsuccessful attempt at reduction an incision was made through the integument covering the coracoid process and glenoid cavity. Hemorrhage was controlled and the muscles were sectioned until the osseous structures were reached. *Difficulties and complications of the operation*: An attempt was made to limit the operation to the outside of the long head of the biceps tendon, but was unsuccessful owing to anatomical difficulties. On opening the capsule the glenoid cavity was found filled with newly formed connective tissue, which was removed. The coracoid process was then broken to give space for reduction. The head of the humerus was found diseased, making removal necessary a little below the anatomical neck. The end of the humerus was then inserted into the glenoid cavity and a drainage-tube inserted. Wound now closed with silk sutures. An antiseptic dressing was put on with a plaster cast covering the shoulder and chest. *Result immediate:* Primary union of wound; paralysis disappeared. *Result remote:* The function of the joint was restored and the patient went home with a fairly useful arm. *Remarks ?.*

CASE LXIII. *1889. Bardeleben.*[205] I. D. O. forward (subcoracoid), anterior incision, resection, result good.

Man, aged 19 years. *Diagnosis:* Luxation präglenoidalis. *Duration:* Eight and a half weeks. *Movements*, etc.: Arthritis, periarthritis. *Operation:* Resection of head. *Complications of the operation:* Shoulder joint surrounded by a quantity of pus; some granulations on the articular surface of the scapula removed. Long biceps tendon could not be found in joint. The head of the humerus was much eroded on the side corresponding to the coracoid process and fixed to the anterior edge of the glenoid cavity; at this point there was a deep notch at the anatomical neck. No tuberculous foci found. At the left of the smaller tubercle in the head of the humerus was a hole the size of a bean, probably due to the pressure of the coracoid process. These changes were due to an arthritis and periarthritis following the old luxation. *Complications after the operation:* Suppuration. *Result immediate:* Wound healed slowly, three and a half months. *Result remote:* Some months later there was good movement in the shoulder-joint, both backward and forward, less upward and outward. *Remarks ?.*

Case LXIV. *1889–90. Kocher, No. 2.*[206] I. D. O. forward (intracoracoid), with fracture of anatomical neck and of greater tuberosity, anterior incision, resection, result good.

Man, aged 52 years. *Diagnosis:* Inveterate intracoracoid subscapular luxation of shoulder. *Duration:* Seven weeks. *Movements,* etc.: Active ones only with the shoulder-blade. Rotation easy. *Operation:* Incision through deltoid, and resection of head of the humerus. *Difficulties and complications of the operation:* There was a fracture of the anatomical neck, and the greater tubercle had been torn off. Subscapular muscle much torn; coraco-brachialis and short head of biceps found torn, and during operation completely broken through. Upper end of humerus rounded off. *Complications after the operation:* None. *Result immediate:* Wound completely healed in three weeks. *Result remote:* Three weeks after operation good active motion. *Remarks:* Attempt at reduction made four weeks after injury; two weeks later a second attempt, when humerus was fractured and a large extravasation occurred, followed by pain.

Case LXV. *1889–90. Kocher, No. 3.*[207] I. D. O. forward (subcoracoid), fracture of anterior edge of the glenoid cavity, anterior incision, resection of head, sepsis, death.

Man, aged 69 years. *Diagnosis:* Subcoracoid luxation of left shoulder. *Duration:* One month and twenty-three days. *Movements,* etc.: Active ones very limited, only possible with help of the shoulder-blade; passive ones fair, abduction 20°, adduction 20°, elevation 30°, rotation limited. Pain and blue discoloration of the arm. *Operation:* Incision along the inner edge of deltoid muscle, capsule extensively incised. Partial resection of upper end of the humerus, and also of interposed portion of remains of the capsule on the anterior edge of glenoid cavity. *Difficulties and complications of the operation:* There was an old fracture of the anterior edge of the glenoid cavity; capsule in neighborhood of head had been torn off in attempts at reduction, had become interposed between the head and cavity. There was no tear seen in the capsule. *Complications after the operation:* Severe suppuration. *Result immediate:* Patient died of sepsis sixteen days after the operation, at a time when there were many cases of infection in the clinic. *Remarks:* No attempt made at reduction until one month after the accident, when it failed, second failure two days before the operation.

Case LXVI. *1889–90. Kocher, No. 4.*[208] I. D. O. forward (subcoracoid), recent fracture in reducing, anterior incision, also old fracture of greater tuberosity, resection, result fair.

Man, aged 56 years. *Diagnosis:* Subcoracoid luxation of right shoulder. *Duration:* Two weeks. *Movements*, etc.: Active ones only possible with shoulder-blade. Passive abduction up to 35°. Rotation slight, with crepitation. Muscles atrophied. Diminished sensibility in distribution of ulnar nerve, also some in distribution of median. Separation of fingers impossible. Hand held in position similar to that following paralysis of ulnar. *Operation:* Incision along the anterior edge of the deltoid; resection of the head. *Difficulties and complications of the operation:* Old fracture of greater tubercle, and head of the humerus is fractured, fracture line passing through the greater tubercle also. Drainage and corrosive dressing. *Complications after the operation:* None. *Result immediate:* Wound healed slowly, closed one month after operation. *Result remote:* No active movements in shoulder-joint when discharged. *Remarks:* No attempt at reduction until patient came to hospital; then one was made, and the humerus was fractured.

Case LXVII. *1889–90. Kocher, No. 5.*[209] I. D. O. forward (subcoracoid), anterior incision, recent fracture of head and tuberosities, during manipulation, removal of the fractured head and resection, improved; the fractures were healed, but refractured in the manipulation.

Male, aged 35 years. *Diagnosis:* Subcoracoid luxation at right shoulder. *Duration:* Three months and six days. *Movements*, etc.: Passive ones tolerably limited; active ones impossible, atrophy of muscles; elbow- and finger-joints free. *Operation:* Incision over middle of upper arm between the shoulder-joint and coracoid process through the fibres of the deltoid muscle. Resection of head. *Difficulties and complications of the operation:* Double fracture of the upper end of humerus found, one through the anatomical neck, by which a deep depression was formed, in which tendon of biceps was firmly imbedded; a second fracture lying medianly to the first, and running along with it outward, by which a portion of the tubercle was broken off. The fractures were healed, but refractured in the manipulations. Capsule at one spot for a distance of one centimetre was firmly clasped in between the head and the cavity. The fractured bone was entirely removed, and the second fracture was rounded off and formed into a head, whose convexity pointed upward. *Complications after the operation:* Suppuration. *Result immediate:* Wound healed slowly. *Result remote:* On discharge, one month after the operation, there was little active motion in the arm; passive motion was good; muscles atrophied, especially the deltoid. *Remarks:* None.

Case LXVIII. *1889-90. Kocher, No. 6.*[210] I. D. O. forward (subcoracoid), anterior incision, old fracture of greater tuberosity, resection, result fair.

Man, aged 57 years. *Diagnosis:* Subcoracoid dislocation of left shoulder. *Duration:* Four months and fourteen days. *Movements*, etc.: Stabbing pain and pressure in left axilla. No active motions possible without movement of shoulder-blade, abduction to 45°. Movements of elbow, wrist and fingers normal. *Operation:* Long incision down to head of humerus through deltoid; removal of the fractured greater tubercle, and the deformed coracoid process; resection of the upper end of the humerus. *Difficulties and complications of the operation:* Due to fragment of bone (fractured great tubercle), found between the head and cavity; and also due to the deltoid, which had become stiff and very tense. *Complications after the operation:* Suppuration, fever, formation of abscess, with severe pains following the radial nerve into the forearm. Incision of abscess and drainage. *Result immediate:* Slow healing of wound. *Result remote:* Two years after operation arm in good position. Elevation to 60°, under strong contraction of the deltoid. Abduction slight. Elevation backward, better. Passive rotation in shoulder-joint 30°, 40°. Passively arm can be raised perpendicularly, and when let down can be held actively almost in a horizontal line. *Remarks:* Dislocation at first mistaken for fracture; three weeks after accident attempts at reposition failed. A week before operation attempt failed again.

Case LXIX. *1899-90. Kocher, No. 8.*[211] I. D. O. forward (subcoracoid), anterior incision; and old fracture of greater tuberosity, resection, result good.

Female, aged 19 years. *Diagnosis:* Subcoracoid dislocation of right shoulder. *Duration:* Eleven months. *Movements*, etc.: Only possible with the shoulder-blade abduction to 45°. *Operation:* Resection of the humerus because of severe disturbance of function. Biceps tendon saved. Drainage and irrigation. *Difficulties and complications of the operation:* Tolerably numerous fibrous adhesions over cartilage surface. Pieces of bone in the posterior wall of the capsule. The greater tubercle, which had evidently been fractured earlier, was firmly united to the head of the humerus. *Complications after the operation:* None. *Result immediate:* Wound healed normally. *Result remote:* On discharge, five weeks after the operation, movements much limited, but stronger than before. Pain only on free movements. Scapula moves with the arm. Two months later patient can

only sew and knit. Can raise arm actively to an angle of 25°. Passively all movements are possible and painless for about 45°. *Remarks:* Unsuccessful attempt made at reduction five weeks after injury; five months after accident arm reduced by Kocher's bloodless method.

Case LXX. *1890. Robson.*[212] I. D. O. forward (subcoracoid), anterior incision, old fracture of greater tuberosity, resection, improved.

Man, aged 16 years. *Diagnosis:* Subcoracoid dislocation of the shoulder. *Duration:* Six weeks. *Movements*, etc.: Not stated. *Operation:* Vertical incision four inches and a half. *Difficulties and complications of the operation:* In addition to dislocation, found a longitudinal fracture separating the greater tuberosity from the shaft, and extending down the bone some distance beyond the line of incision; resection; reduction could not be effected on account of the glenoid cavity being filled with callus and plastic material thrown out around the fracture; resection. *Complications after the operation: ? Result immediate:* Healing in nine days. *Result remote:* Good range of movement in arm'; intends resuming his work in a short time. *Remarks ?.*

Case LXXI. *1890. Hinsel (Heinrich).*[213] I. D. O. forward (intracoracoid), anterior incision, resection; result fair.

Man, aged 36 years. *Diagnosis:* Intracoracoid dislocation. *Duration:* Nine months. *Movements*, etc: Sensation of formication in the forearm. *Operation:* Incision (?), resection. *Complications after the operation: ? Result immediate:* Healing in twelve week. *Result remote:* Motions pretty good, nervous phenomena have disappeared entirely. *Remarks ?.*

Case LXXII. *1890. Phelps (Charles).*[214] I. D. O. forward (subcoracoid), anterior incision, resection; result good.

Man, aged ? years. *Diagnosis:* Subcoracoid dislocation. *Duration: ? Movements*, etc.: ? *Operation:* Incision (?), resection of the head. *Difficulties and complications of the operation: ? Complications after the operation:* Suppuration lasting for weeks. *Result immediate:* Sinuses persisted. *Result remote: ? Remarks ?.*

Case LXXIII. *1891. Wolfler No. 2,*[215] from Smital. I. D. O. forward (intracoracoid), anterior incision, resection; result good.

Man, aged 26 years. *Diagnosis:* Intracoracoid dislocation. *Duration:* Nine months. *Movements*, etc., of right arm tolerably free, but did not suffice for occupation of patient (farrier). The right arm, when the body was held comparatively still, could, by help of movement of shoulder-blade, be raised forward and outward to a horizontal

line. Elbow-joint almost normal, though it could not be fully extended. Dorsal flexion, abduction and adduction of the hand are somewhat difficult. There is itching in entire forearm and at times shooting pains through the whole upper extremity. Writing is impossible. Muscles of the shoulder somewhat atrophied. Acromial portion of deltoid muscle does not react at all to electric current, the clavicular portion reacts weakly. *Operation:* Slightly convexed incision twenty centimetres long, between the deltoid and pectoralis region; the pectoralis minor, which was partially torn by the head of the humerus, was incised, the thickened wall of the capsule was cut through, the biceps tendon was laid bare (at one point it was partially cut through and later united again), and the head was resected. The old cavity was filled up with arthritis deposit and scar tissue; there was no appreciable capsule or cavity; it was cleaned out with knife and spoon. Arm put up in position of abduction, the wound cavity, especially the new glenoid cavity, was filled with sublimate gauze, and iodoform gauze enclosed therein; drainage at lower end of wound, provisionary stitches, iodoform bandage, and over this a Desault bandage. *Difficulties and complications of the operation:* None. *Complications after the operation:* None. *Result immediate:* Primary union. *Result remote:* The curve of shoulder not quite round, the acromion projects, since the acromial portion of the deltoid muscle has remained atrophied, and the clavicular portion is markedly hypertrophied; and the pectoralis major has again developed markedly. The scar is firm. The musculature of the upper and lower arm is as strong as the left. Patient can write as well as he did before the accident. Pain and other nervous symptoms have entirely left. Movements of the shoulder-joint reached forward well to a horizontal line, also in the side; movements backward as good as on the left side, in which position the patient can hold his arm fixed. The patient lacks this power of fixation only in elevation complete, and elevation is possible with a slight swing. But even this condition, this slight dangling of the joint, will surely improve.

Case LXXIV. *1891. Thornburn.*[216] I. D. O. forward (subclavicular), anterior incision, old fracture of greater tuberosity, resection; result good.

Male, aged 15 years. *Diagnosis:* Subclavicular dislocation. *Duration:* Three months. *Movements*, etc.: Only movements which could be effected were those of the scapula, and these were slight; limb almost useless. *Operation:* Incision about four inches in length in

front of the upper end of humerus and rather to the outer side of its axis; the end of the shaft being rounded off a little, the reflected periosteum was drawn over it and secured by two catgut sutures; drainage-tube through the shoulder, an opening made behind the deltoid. Pad placed in the axilla and arm brought to the side so that the upper end of the humerus should be in contact with the glenoid cavity. *Difficulties and complications of the operation:* Upper end of the humerus found to consist of an irregular mass of bone, very soft, vascular, and evidently in part of new formation, without any trace of articular cartilage; a bony fragment about twice the size of a hazel-nut, and corresponding apparently to the greater tuberosity, was found detached and lying posteriorly. Humerus was projected from the wound and sawn across as nearly as could be judged in the position of the surgical neck; the isolated fragment of bone was also removed. No difficulty was experienced in now placing the end of the shaft into the glenoid cavity. The parts were very vascular, as was the end of the bone, and a number of small vessels were ligated. *Complications after the operation:* None. *Result immediate:* Wound healed satisfactorily and patient dismissed in less than three weeks, at which time passive movements could be made freely and painlessly performed. *Result remote:* Eleven months later, patient is earning his living as a clerk. Arm is two inches shorter than the other, and can use it for almost any purpose. The only movement which is limited is that of elevation in the abducted position; he cannot raise the humerus quite to the horizontal. Rotation of humerus is fairly well performed. *Remarks:* None.

Case LXXV. *1891. Gwyer.*[217] I. D. O. forward (intracoracoid), anterior incision, old fracture of greater tuberosity, resection, result good.

Woman, aged 51 years. *Diagnosis:* Intracoracoid dislocation. *Duration:* Two months. *Movements*, etc.: Motion in the joint almost negative, forward and backward movements being limited to about ten degrees; abduction possible to about four inches from the trunk; rotation entirely absent. Paralysis and some atrophy of the deltoid and slight atrophy of the muscles of the hand, with loss of usefulness of the hand and of the entire extremity; continuous and increasing pain in the whole limb. *Operation:* Incision from the top of the coracoid process to about the level of the attachment of the deltoid. *Difficulties and complications of the operation:* On reaching the deeper parts nothing was found to guide, striking a region of newly formed

connective tissue extending over the whole area; head of the bone deeply imbedded in fibrous tissue lying close under the clavicle to the inner side of the coracoid process and resting on the ribs; the greater tuberosity had been broken off, but remained connected to the head by fibrous tissue; removal of the tuberosity and attempt to free the head sufficiently to raise it out of the wound; this could not be done, so the shaft was freed just below the surgical (?) neck and the bone divided with a chain saw; the neck was then grasped with strong forceps, and after a good deal of hard work with a periosteal elevator, the knife being used sparingly, the head was finally freed and removed; there existed a large cavity where the head had rested; the glenoid cavity was found filled with fibrous tissue. *Complications after the operation:* None. *Result immediate:* Primary union. *Result remote:* Six weeks after the operation only limited amount of voluntary motion; passive motion limited and accompanied by great pain; deltoid paralysis persistent. Four months after operation abduction possible to ten inches from the trunk; rotation slight, forward and backward movements quite marked; no more pain; ability to raise the hand to the forehead and pass it behind the back; can use her hand in dressing herself and in eating and drinking, which she could not do at all before; can perform ordinary housework, such as sweeping, carrying water, etc., without the least inconvenience. *Remarks:* None.

Case LXXVI. *1893. Owen, No. 1.*[218] I. D. O. forward (subglenoid), anterior incision, resection, result improved.

Female, aged (?). She says her age is 42. Author thinks she has omitted to reckon something more than a decade. *Diagnosis:* Subglenoid luxation. *Duration:* Two months. *Movements*, etc.: Not stated. *Operation:* A four-inch incision descending from beneath the clavicle midway between the acromion and coracoid processes; the incision passed a little to the outer side of the groove between the pectoralis major and the deltoid, so as to avoid wounding the cephalic vein; it traversed the anterior fibres of the deltoid. The capsule of the joint having been opened, and the tendon of the origin of the long head of biceps having been lifted out of its bed, the arm was rolled outward and the subscapularis detached from the lesser tuberosity. It was then rolled inward, and the supra- and infraspinatus and the teres minor were detached from the greater tuberosity. Then the end of the bone was thrust through the wound, freed from all attachments behind, and sawn off with a wide oblong saw, close below the tuber-

osities. The wound was closed by a deep continuous suture, except at the lowest point, where a drainage-tube was left for twenty-four hours. *Difficulties and complications of the operation: ? Complications after the operation: ? Result immediate:* Wound healed promptly and practically without suppuration. *Result remote:* Patient much more comfortable since operation, lost all pain in the arm, and beginning to use the arm with ease and success. *Remarks ?.*

Case LXXVII. *1893. Owen, No. 3.*[219] I. D. O. forward (subcoracoid), anterior incision, old fracture of head and removal, resection of tuberosities, result good.

Female, aged 40 years. *Diagnosis:* Fracture with dislocation, arm stiff and painful; there was much thickening about the head of the humerus, which could be felt in the arm-pit. There was anæsthesia of the left hand. Wrist and fingers absolutely stiff, and about one-third of an inch shortening. *Duration: ? Movements*, etc.:? *Operation:* Incision was made through the anterior fibres of the deltoid, and the articular surface of the head of the bone was found in the subcoracoid region. There was a complete fracture through the anatomical neck, with some comminution of the tuberosities. *Difficulties and complications of the operation: ? Complications after the operation: ? Result immediate:* Wound promptly healed, and, by massage and manipulations, she has recovered not a llttle use of the arm. *Result remote:* She can get her hand to the back of her head, and is able to use her fingers. *Remarks ?.*

Case LXXVIII. *1893. Mac Cormac.*[220] I. D. O. forward (intracoracoid), anterior incision, resection, result fair.

Man, aged (?) years. *Diagnosis:* Intracoracoid. *Duration:* Eighteen months. *Movements*, etc.: Arm atrophied and useless, great and continuous pains. *Operation:* Anterior incision (?), resection of head. *Difficulties and complications of the operation:* Glenoid cavity obliterated, so that reduction is impossible. *Complications after the operation: ? Result immediate: ? Result remote:* Pain disappeared and arm became pretty useful. *Remarks ?.*

Case LXXIX. *1893. Delbet (Pierre.)*[221] I. D. O. forward (subcoracoid), incision posterior, then anterior, resection, result good.

Man, aged 33 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Six weeks. *Movements*, etc.: Limb immobile, voluntary movements nul; passive movements very limited; arm can be flexed and extended for a few degrees, but abduction and rotation without movement of the scapula impossible; shoulder muscles noticeably atrophied;

no signs of compression. *Operation:* Incision two centimetres long behind, along the posterior border of the deltoid; this muscle is raised, and there appears a mass of fibrous tissue, thick and resistant, which masks completely the cup and neck of the humerus; removal of all this tissue that can be reached from behind. *Difficulties and complications of the operation:* Impossible to reduce or even loosen the head, and it is impossible to pry the head into the posterior orifice; abandonment of the posterior course. Incision in front in interpectoro-deltoid; a layer of fibrous tissue two millimetres in thickness has to be traversed before reaching the cartilage of the head; incision of all the tissue around the neck; the head is seen then, and without any deformity; impossible to reduce in spite of all efforts; resection of the head with the gouge, then with the saw through the anatomical neck. Suture of the two wounds without drainage. *Complications after the operation:* None. *Result immediate:* Primary union; on the eighth day passive movements begun; after the fifteenth day passive movements, massage, electricity, were kept up regularly. *Result remote:* Two months after the operation the patient can easily place his hand on the shoulder and on the head; movements of flexion and extension are normal, rotation inward limited; abduction (the scapula being fixed) also limited; rotation externally almost nul. Five months later the conformation of the shoulder is normal; the upper extremity of the humerus is under the acromion, but is slightly enlarged; the arm is strong and permits of hard work, but the mobility is rather diminished than increased. Active movements; flexion and extension (*i. e.*, movements of elevation forward and backward) can be made to the horizontal; abduction without participation of the scapula permits the elbow to be carried to nineteen centimetres from the trunk; the hand is easily carried upon the sound shoulder and on the buttock of the opposite side; it is carried to the top of the head with some little effort; it can be carried to the nucha, but with difficulty, by bending the head very much. Passive movements; flexion, extension and reduction are no more extensive than in the active movements; rotation inward measures but a few degrees, and is accompanied by crackling; external rotation is nul. The patient can do his work (butcher) so well that his companions had never noticed anything peculiar. *Remarks:* The result would have been still better if at one time the regular treatment had not been suspended and the arm placed in a sling for awhile.

Case LXXX. *1894. Porter (Charles B.).*[223] I. D. O. simple, forward

(subcoracoid) V-shaped incision, resection difficult; some secondary hemorrhage, necrosis of bone, result improved.

Man, aged 72 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Seven and a half months. *Movements*, etc.: Great atrophy of the deltoid, scapula moves with the humerus; patient can raise elbow but a short distance from side; cannot put hand behind his back; complains of pain and a queer sensation in the hand. *Operation*; V-shaped incision, carried down to the bone; on feeling at the internal superior angle of the wound, the coracoid process was found and dissected with a blunt instrument. *Difficulties and complications of the operation:* Head of the humerus firmly bound down, immovable; glenoid cavity entirely filled up; bone sawed below the head, upper fragment then grasped with the lion-jawed forceps; manipulation in all directions, and dissection by a blunt dissector; finally, it is pried and twisted out of position; in doing so several bits of bone were torn off from it; general oozing. *Complications after the operation:* Oozing for thirty-six hours. *Result immediate:* Suppuration. *Result remote:* Long suppuration; small spiculæ of bone removed; discharged improved, fistula still remaining. *Remarks ?.*

Case LXXXI. *1894. Wyeth (J. A.).*[223] I. D. O. forward (subcoracoid), anterior incision, resection, result good.

Man, aged about 50 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Four years. *Movements*, etc.: *?* *Operation:* Incision, (?) resection. *Difficulties and complications of the operation: ? Complications after the operation: ? Result immediate:* Recovery. *Result remote:* Has been doing nicely. *Remarks ?.*

Case LXXXII. *1895. Monks (G. H.).*[224] I. D. O. forward (subcoracoid), anterior incision, resection, improved.

Man, aged 59 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Ten months. *Movements*, etc.: Atrophy of all the muscles of the shoulder-joint, as well of the arm and hand; patient's grasp very weak; voluntary movements very limited; condition of the nerves determined by Dr. Prince, neurologist of Boston City Hospital, reveals complete ulnar paralysis and partial paralysis of the median, musculo-spiral, and circumflex nerves; the man declares his arm is practically useless and that daily he seems to be losing power in it. *Operation:* Incision at the anterior margin of the deltoid; division of the supraspinous, infraspinous, small round, and subscapular; the long tendon of the biceps was dislocated from its groove, but not divided; head of humerus very much atrophied; on being removed it

could be easily crushed by the bone forceps, showing that had an attempt been made to reduce the dislocation by manipulation, a fracture would have taken place at the neck of the bone. *Difficulties and complications of the operation:* None. *Complications after the operation:* None. *Result immediate:* Primary union. *Result remote:* A sufficient time had not elapsed when the patient left the hospital to enable to state how much the patient gained in the use of his limb; thus far the man has a wider range of motion of the arm and can use his hand better; condition of the nerves also much improved. *Remarks:* At the time of the accident the dislocation was reduced, but that same night the head of the bone dropped out of the socket again; the next day it was again put back, but dropped out again soon after.

Case LXXXIII. *1895. Lejars, No. 1.*[225] I. D. O. forward (subcoracoid), anterior incision, old fractured head, resection, *i. e.*, removal, death.

Female, aged 57 years. *Diagnosis:* Irreducible subcoracoid luxation of left shoulder, complicated by fracture of the anatomical neck and displacement of the head of the humerus into the axilla. *Duration:* Two and a half months. *Movements*, etc.: Complete loss of power, and marked atrophy of the deltoid. *Operation:* Anterior incision, ligature and section of cephalic vein outward of the coracobiceps; dissection little by little, from without inward, of the vascular nerve bundle which lay immediately in front of head of humerus, adherent to it, and stretched; finally broken head of humerus is freed, the humerus minus the head, after being trimmed with the scissors, is replaced in the glenoid cavity; through a complementary posterior incision behind the anterior edge of the axilla the head is removed. *Difficulties and complications of the operation:* The separated head, dislocated forward and downward was entirely concealed by the vasculonervous plexus, and was only united to the shaft by a few fibrous strands and some osseous stalactites, which were destroyed without difficulty, but its relations were so intimate with the vessels and nerves that instead of making a dangerous attempt to free it from in front, it was removed by the posterior incision. *Complications after the operation:* None. *Result immediate:* Supposedly primary union. *Result remote:* Death in six days from pneumonia. *Remarks ?.*

Case LXXXIV. *1895. Lejars, No. 2.*[226] I. D. O. forward (subcoracoid), anterior incision, resection, result not stated.

Male, age ?. *Diagnosis: ? Duration:* One year. *Movements*, etc.: Deltoid atrophied, abduction and rotation of arm impossible. *Opera-*

tion: Long anterior incision at the edge of the pectoro-deltoid fold; cephalic vein ligated and cut; then separating and cutting the muscles and capsules, the luxated head was finally removed. *Difficulties and complications of the operation:* The head was held down posteriorly, and was entirely surrounded by a cicatricial fibrous tissue, which completely enveloped it, and descended down around the neck, covered both tuberosities, and involved the glenoid cavity, which was completely masked by a compact and woven mass. The lesser pectoral muscle was sclerosed and retracted, and circled the neck of the humerus like a bridle and prevented all isolation of the head. The muscle had to be cut through. The glenoid cavity had to be freed of the fibrous mass which filled it, and was found rough, without cartilage and cracked. *Complications after the operation:* ? *Result immediate:* ? *Result remote:* ? *Remarks:* This is all that is to be said about the case. The author simply mentions it in talking of his other case, and it is not given in full.

Case LXXXV. *1895. Bickham and Souchon.*[221] I. D. O. forward (subcoracoid), anterior incision, resection, improved.

Man, aged 32 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Nine months. *Movements*, etc.: Muscles of whole of upper limb considerably atrophied, all movements very limited. *Operation:* Incision near the anterior edge of deltoid through an old scar which resulted from an attempt made about six months previously to resect the head; the head was found to be so deep and so firmly bound down that the operation was then abandoned. *Difficulties and complications of the operation:* Very strong adhesions bound circumference of the head to the surrounding parts; also the cartilaginous surface gives insertions to these fibrous bands; the head is so fixed that rotation to any extent is impossible; after much trouble the dissection, proceeding from behind forward (toward the large vessels in front) struck a portion of the surface of the head which was free from adhesions; this portion was about as large as a silver quarter; thence the balance of the detachment was comparatively easy; kept close to the bone all the time, specially when operating on the front part of the head; the head much enlarged, about one fourth more than its normal size; a portion of it had to be chiselled off to make room to penetrate more deeply; it is very hard; horizontal section with the saw on a line with the lower margin of the head; drainage-tubes. *Complications after the operation:* Although great care had been taken to stop all bleeding, yet the patient presented secondary hemorrhage a few

hours later; had to be transfused; suppuration. *Result remote:* Resected extremity became fixed in its new position near the cup in spite of treatment; however, it may be that not enough of the bone had been resected, and that the passive movements had not been begun early enough. However, patient enjoys a greater range of motion than before, but the scapula moves with the humerus. Can eat with his hand. Muscles remain atrophied. Improvement continues. *Remarks:* It is probable that the previous attempt, which had been followed by suppuration, was the cause of the extent and toughness of the adhesions; also of the hypertrophied condition of the head.

Case LXXXVI. *1895. Schmittle (Julius F.).*[228] I. D. O forward (subcoracoid), anterior incision, resection, result good.

Woman, aged 45 years. *Diagnosis:* Subcoracoid *dislocation. Duration:* Twenty-six months. *Movements*, etc.: Movements very limited; arm atrophied. *Operation:* Vertical incision from acromion process down about three inches in length; muscles about the head removed, together with periosteum; bone sawn through at the surgical neck. *Difficulties and complications of the operation:* None. *Complications after the operation:* None. *Result immediate:* Primary union; the wound was not dressed for fifteen days after the operation. *Result remote:* At the end of a month she was told to make use of her arm, which she did with celerity. Three months after the operation she had good use of her arm; there was, however, some impediment to external and internal rotation. *Remarks:* None.

Case LXXXVII. *1896. Boone (W. H.).*[229] I. D. O. forward (subcoracoid), anterior incision, resection, result good.

Male, aged 22 years. Chinaman. *Diagnosis:* Subcoracoid dislocation, head prominent beneath the subcoracoid. *Duration:* Forty days. *Movements*, etc.: Cannot move his arm at all, severe pain. *Operation:* Incision through the deltoid muscle to the capsule and periosteum, drew aside the margins of the wound with retractors, and opened into the joint; excised head. *Difficulties and complications of the operation:* Firm adhesions; more than ordinarily difficult; head of bone remaining fixed, even when freed from the ligaments and muscular insertions; head of bone was thrust out of the wound and removed at the anatomical neck by a narrow-back saw passed behind it; there was no difficulty in getting the bone in place, drainage-tube inserted, iodoform dressings applied, the arm retained upon a triangular cushion; wound sutured with catgut. *Complications after the operation:* None. *Result immediate:* Wound healed in ten days. *Result remote:* Four

weeks after admission has free motion of shoulder; can put his hand on his head; able to earn his living. *Remarks ?.*

Case LXXXVIII. *1896. Bremken.*[230] I. D. O. forward (intracoracoid), interior incision, resection, result good.

Female, aged 50 years. *Diagnosis:* Intracoracoid, we might also say subclavicular luxation of right shoulder. *Duration:* Six months. *Movements*, etc.: All very much limited on account of severe pain. *Operation:* Antero-internal incision, avoiding terminal ends of circumflex nerve. Head exposed and capsule freely incised. Head resected, glenoid cavity freed of fibrous tissue. Wound sewed up; small drain. *Difficuties and complications of the operation:* Old glenoid cavity much reduced and modified; instead of being concave it was flat, and surface was so reduced in size that it did not admit end of humerus, even after head was resected. A new cavity was formed in the shoulder-blade, below the old glenoid cavity, sufficiently large to hold the humeral epiphysis perfectly. *Complications after the operation:* None. *Result immediate:* Wound completely healed six days after operation. *Result remote:* Nine months after the operation patient could wash, sweep, scrub, pump, raise heavy weights and move furniture. Pain had ceased immediately after operation. She could use her right arm almost as well as left, and strength of both seemed equal. *Remarks:* The shoulder was so swollen at time of accident that no attempt at reduction was made until a week later, when it failed. Other unsuccessful attempts also made.

Case LXXXIX. *1896. Chénieux.*[231] I. D. O. forward (intracoracoid), anterior incision, resection, result good.

Male, aged 20 years. *Diagnosis:* Intracoracoid luxation of right shoulder. *Duration:* Thirteen months. *Movements*, etc.: Could not raise his hand above face. Internal and external rotation practically lost, could not bring forearm backward. *Operation:* Resection of head. *Difficulties and complications of the operation:* Due to the fact that the head was firmly held down by adhesion; and that tendon of subscapular muscle had to be cut through in order to free head. The tendons of the supra- and subspinous muscles and the small round tendon had been broken, and had no connection with the greater tuberosity. There was a large amount of cicatricial tissue, remnant of the capsule, which occupied the glenoid cavity and subacromial space, which had to be cut away. *Complications after the operation:* None, no suppuration. *Result immediate:* ? *Result remote:* Hand

could be carried to top of head one month after operation. *Remarks:* Both shoulders had been dislocated as a result of a nocturnal epileptic attack. Luxations had not been recognized, and apparently no attempts at reduction had been made.

Case XC. *1896. Erdmann (John).*[232] I. D. O. forward (subcoracoid), anterior incision, old fracture of head; refractured head chiselled off, resection, result good.

Man, aged 44 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Ten months. *Movements*, etc.: Marked emaciation of the upper half of the trunk, flattening of the shoulders; prominence within one inch under surface of the clavicle; large and round mass beneath the coracoid; evidence of some bony substance filling the glenoid cavity, A diagnosis of fracture of the head of the humerus with dislocation and possible fracture of coracoid process. While manipulating the arm, after anæsthesia, a distinct snap was heard, the arm became freely mobile, with crepitation. *Operation:* Incision and resection. *Difficulties and complications of the operation:* A mass of callus was found on the site of the greater tuberosity and anteriorly into the glenoid fossæ, while internally and beneath the coracoid process the head of the bone was found; these two portions were separated by a fissure from which there was free oozing; the fissure accounted for the snapping heard during the manipulation, and was a fracture of the head from the side of the shaft where it had become attached by callus. Head of the humerus chiselled out. The anterior half of the glenoid cavity had been broken and was solidly united with the head of the humerus. Long head of the biceps was imbedded in a mass of callus on the humeral head, and by pressure had been atrophied to one-half its size at other points. The callus upon the greater tuberosity was removed with a saw. Sutures, etc. *Complications after the operation:* ? *Result immediate:* Twenty days after, drainage removed and passive movements begun. *Result remote:* Three months after the operation the patient could abduct the arm to 45°, could place the hand on the opposite shoulder, forward and backward motion was good, rotation slight. Functions of the elbow, wrist, and fingers were excellent. *Remarks* ?.

Case XCI. *1897. Vander Veer.*[233] I. D. O. forward (subcoracoid), with fracture of the surgical neck, refracture in trying to reduce; operation immediate; anterior incision, resection of upper fragment; hemorrhage during operation; amputation at shoulder; death on second day from exhaustion.

Woman, aged 63 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Three and a half months. *Movements*, etc.: Great pain, atrophy of muscles of limb. *Operation:* After attempt had been made to reduce by Kocher's method and by the heel process it was discovered that the humerus was fractured; patient was operated on immediately; incision made to the inner side of the glenoid cavity from the coracoid process down to the point below the surgical neck. *Difficulties and complications of the operation:* As soon as fractured ends were exposed venous hemorrhage became very profuse, and was not easily controlled; upper shaft (fragment) of humerus removed with chain saw; bone soft, indicating that there had not been perfect union; capsule of joint opened into and bone rolled out from underneath the coracoid process; arterial hemorrhage became very profuse; the subclavian was controlled, but hemorrhage was from so many points that, together with recognized impaired nerve-supply to arm and forearm, and in consideration of her time of life, it was believed best not to attempt ligation of subclavian, feeling that gangrene of arm and death would surely follow. It was decided to do a shoulder-joint amputation. This was done as quickly as possible; vessels ligated with silk; also all bleeding-points, of which there were a great many. Axillary nerves were all matted together by adhesive inflammation and was hard to recognize. *Complications after the operation:* Little oozing; patient gradually became weaker, and died of exhaustion at the end of twenty hours. *Remarks ?.*

HISTORIES OF I. D. O. FORWARD TREATED THROUGH AN AXILLARY INCISION BY REDUCTION.

Case XCII. *1889–90. Kocher.*[234] I. D. O. forward (intracoracoid), fracture of greater tuberosity, axillary incision, reduction, later resection; improved.

Male, aged 58 years. *Diagnosis:* Luxation of right shoulder, subscapular (intracoracoid). *Duration:* Five weeks. *Movements*, etc.: Active ones almost impossible. Arm readily movable on passive motion, but it cannot be brought close to body. *Operation:* Incision into axilla behind vessels and nerves parallel with them, reduction impossible; resection of greater tubercle followed by reduction of head. *Difficulties and complications of the operation:* Capsule much thickened. The greater tubercle, which was broken off, was adherent to the tendons of the supra- and infraspinatus muscles, and was pressed against

the glenoid cavity by the tense capsule, the posterior portion of which was drawn forward. *Complications after the operation:* Suppuration. *Result immediate:* Slow granulation of wound; resection of head. *Result remote:* Seven months after the operation there was almost complete anchylosis of the shoulder. Slight movement possible. Elbow cannot be fully extended. Flexion free; cannot close hand fully. Eleven months after operation, complete fibrous anchylosis of shoulder. Marked atrophy of deltoid. Discharging fistula at site of old operation; patient died five years later, insane, and fistula was still open. *Remarks ?.*

HISTORIES OF I. D. O. TREATED THROUGH AN AXILLARY INCISION BY RESECTION.

CASE XCIII. *1860. Langenbeck.*[235] I. D. O. forward (axillary), with old fracture of greater tuberosity, axillary incision, resection, result improved.

Man, aged 45 years. *Diagnosis:* Axillary dislocation of right shoulder. *Duration:* Five months. *Movements*, etc.: Evidence of pressure in the brachial plexus. *Operation:* Axillary incision; resection of head easily performed. *Difficulties and complications of the operation:* The greater tuberosity was fractured. *Complications after the operation:* None. *Result immediate:* Healing almost altogether primary. *Result remote:* At the sixth week the muscles reacted well to the induced current, but the usefulness of the limb was but little improved. *Remarks* ?.

CASE XCIV. *1873. Lister.*[236] I. D. O. forward (subcoracoid), rupture of artery during efforts to reduce before cutting, axillary incision, ligation, resection, death.

Man, aged 58 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Six weeks. *Movements*, etc.: ? *Operation:* An attempt was made at reduction by manipulation and pulleys, no very great force being used; this was unsuccessful, and the efforts at reduction were no sooner discontinued than a large swelling was noticed below and behind the axilla; no pulse at the wrist. At once cut down into the axilla and turned out a mass of clots; found nothing wrong in the lower part of the artery except absence of pulsation; then divided both pectoral muscles to the clavicle, and there discovered a rent in the artery a sixth of an inch long. Artery tied above and below the rent. Head then resected and the humerus placed in normal position. *Difficulties and*

complications of the operation: None as regards the resection. *Result immediate:* Patient rallied somewhat, but died three hours after the operation. Post-mortem examination revealed that the artery had become attached by an osteo-fibrous band to the coracoid process, on the one hand, and to the neck of the humerus, on the other, and this had been torn across during manipulation at the point of its attachment to the artery. *Remarks* ?.

Case XCV. *1896. Spieker, No. 1.*[237] I. D. O. forward (subcoracoid), with fracture of greater tuberosity, axillary incision, resection, improved.

Man, aged 45 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Five and a half months. *Movements*, etc.: Arm could not be moved at elbow or wrist; sense of formication; arm hangs in pronation; supination can only be half carried out. Extension of fingers very slight, and in last three only at the metacarpo-phalangeal joint; separation of fingers practically impossible; the fingers are in a position of extension; the individual phalangeal joints are stiff but not ankylosed, but very painful when moved passively; there is anæsthesia in the extension and flexor surfaces of the last three fingers; sensation in arm generally diminished. *Operation:* Incision along posterior edge of the coracobrachialis muscle. After cutting through skin and axillary fascia, head free. Head resected; salicylic acid dressing without drainage. *Difficulties and complications of the operation:* Muscles had been entirely torn off from the lesser tubercle, and the greater tubercle was found separated from the head, possibly as result of attempt at reduction. *Complications after the operation:* Slight suppuration. *Result immediate:* Wound healed slowly. *Result remote:* About six weeks after operation movements in arm a little better than before operation, though muscles reacted well to electric current. *Remarks* ?.

Case XCVI. *1876. Spieker, No. 2.*[238] I. D. O. forward (subcoracoid), dislocation, axillary incision, resection.

Man, aged 40 years. *Diagnosis;* Subcoracoid luxation. *Duration:* Five weeks. *Movements*, etc. ? *Operation:* Incision along middle of axilla parallel to long axis of humerus. Periosteum separated; head resected, antiseptic dressing without drainage. *Difficulties and complications of the operation:* The greater tubercle was found broken off. *Complications after the operation:* Extensive suppuration followed by general septicæmia. *Result:* Death three weeks after operation due to pyæmia. *Remarks:* No immediate attempt at reduction after operation made, but several made unsuccessfully before operation. As result

of last of these shoulder became much swollen and very painful and complicated with a large extravasation of blood.

Case XCVII. *1877. Langenbeck, No. 1*[239] *(in Kronlein).* I. D. O. forward (axillary, *i. e.*, subcoracoid), with old fracture of great tuberosity, axillary incision, improved slightly.

Man, aged 45 years. *Diagnosis:* Axillary luxation. *Duration:* Five months old. *Movements*, etc.: Symptoms of pressure on brachial plexus, formication, impossibility to make movements at elbow and wrist, hand held in pronation and can with difficulty be brought into half supination. Joints of fingers stiff, but allow passive movements. Sensibility of forearm much diminished. Reaction muscles of forearm to induced currents very weak. *Operation:* Resection of head according to Langenbeck's method. *Difficulties and complications of the operation:* Great tuberosity was found broken off. *Complications after the operation:* None. *Result immediate*: Wound healed by first intention. *Result remote:* Six weeks after operation muscles react well to induction currents, but use of arm had improved but little. *Remarks:* One attempt made at reposition before operation failed.

Case XCVIII. *1877. Langenbeck, No. 2*[240] *(in Kronlein).* I. D. O. forward (subcoracoid), axillary incision, resection, death.

Male, aged 41 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Five weeks. *Movements*, etc.: Movements in upper arm nul; neither axillary nor radial arteries could be felt to pulsate; sensibility retained in whole arm. *Operation:* Resection of head according to Langenbeck's method, axillary incision. *Difficulties and complications of the operation:* It was laborious, since the head was more deeply situated than appeared; considerable hemorrhage; ligature of many vessels, probably of scapular artery in depth of wound. *Complications after the operation:* Axillary abscess. *Result immediate*: Erysipelas. *Result remote:* Death the fourth week after operation. *Remarks*: Attempts were made at reposition without success a week before operation, and these were followed by severe local reaction, swelling, pain of shoulder and right side of chest. At autopsy there was found a gangrenous osteomyelitis of humerus and gangrenous thrombi in the course of the brachial and radial arteries and veins as far up as the axilla.

Case XCIX. *1882. Volkmann.*[241] I. D. O. forward (subcoracoid), with fracture of lesser tuberosity, axillary incision, resection, improved.

Man, aged 55 years, very vigorous. *Diagnosis:* Subcoracoid dislocation. *Duration:* Five weeks. *Movements*, etc.: Œdema of lower

arm, crepitation felt on rotating the arm. *Operation:* Axillary incision of Langenbeck; resection. *Difficulties and complications of the operation:* Only due to injury of vein, which may have been due to attempts at reposition or to a sharp fragment of bone, the size of a phalanx, which came from the humerus at site of the lesser tubercle, and which was found in the wound, still attached to the periosteum. After the resection there was still so much obstruction from the soft tissues that it was impossible to bring the humerus into an exactly correct position. *Complications after the operation:* None. *Result immediate:* Healing by first intention. *Result remote:* The patient was discharged at the end of five weeks, with good position and good passive movements of arm. Final result unknown. *Remarks:* Three attempts at reposition were unsuccessful, these were made just before the operation.

CASE C. *1888. Nelaton.*[242] I. D.O. forward (subcoracoid), axillary incision, resection, result?

Female, aged 57 years. *Diagnosis:* Subcoracoid luxation. *Duration:* Three months. *Movements*, etc.? *Operation:* Long axillary incision was made over the displaced head; the vasculo-nerve bundle was turned upward. Incision made through the fibrous tissue which covered the head; head of humerus resected. *Difficulties and complications of the operation:* An attempt at reducing the dislocation was made, but this was impossible, because, although the glenoid cavity was free at almost all points, at one point posteriorly the capsule was stretched and retracted and withstood all attempts to distend it. In other words, the posterior portion of the articular capsule was flattened against the glenoid cavity, was thickened and did not permit itself to be sufficiently separated to allow head to be reduced. To overcome this obstacle it would have been necessary to split it crosswise; but the incision having been made in the axilla, the capsule could only be reached, with the tip of the finger, from deep in the wound, and it would have been difficult to introduce a bistoury, so resection was done. *Result immediate:* ? *Result remote:* ? *Remarks:* No further notes of the case are given.

HISTORIES OF I. D. O. AND FORWARD, TREATED THROUGH A POSTERIOR INCISION BY REDUCTION.

CASE CI. *1885. Schonborn No. 3.*[243] I. D. O. forward (subcoracoid), posterior incision, reduction, result not stated.

Man, aged 42 years. *Diagnosis:* Subcoracoid dislocation. *Dura-*

tion: Nine weeks. *Movements*, etc.: ? *Operation:* A posterior incision on the outer side of the arm through skin and deltoid, ten centimetres long; removal of the remnants of the capsular ligament. *Difficulties and complications of the operation:* After repeated attempts, reduction was effected. *Complications after the operation:* A fortnight later, when the dressings were changed, luxation occurred in an internal and anterior direction; this luxation was reduced on the following day under anæsthesia; again at the next change of dressing, evident displacement of the head once more inward and forward took place. *Result immediate:* The healing of the wound was even. *Result remote:* At the time of his discharge, six weeks later, the conditions of the functions of the limb are not mentioned: *Remarks:* During an attempt to reduce under anæsthesia, before the operation, a transverse fracture of the scapula had resulted below the spine. It was after these fragments had united that bloody reposition was undertaken.

Case CII. *1895. Mudd* (*H. H.*).[442] I. D. O. forward (subcoracoid), incision posterior (Kocher's), arthrotomy, reduction, result good.

Man, aged 50 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Fourteen months. *Movements*, etc.: Could not use forearm in his work (glass-blower); no pressure symptoms, but muscular power weak. *Operation:* Joint exposed after Kocher's method of posterior resection of the shoulder-joint; capsule incised at right angles to the glenoid fossa, so as to expose the joint; absolutely no change in the glenoid fossa; small amount of mucoid tissue in the fossa; capsule of the joint thickened and apparently shortened, stretched tightly over the glenoid fossa; head of the bone could not be forced back into the socket until after the capsule was loosened, because of the shortening on the posterior surface; no adhesion of the parts outside to prevent reduction, the opening of the glenoid cavity being large enough for its entrance; replacing of the acromion in position. *Difficulties and complications of the operation:* The acromion process was with difficulty pressed back into position; sutures, etc. *Complications after the operation:* ? *Result immediate:* No suppuration, slight discharge for some weeks from the capsule at the site of fracture. *Result remote:* Movements and use of limb improved; when seen last, movements somewhat limited; could not lift his arm to right angle; rotary movement improved; no pain, except in limitations of movement.

HISTORIES OF CASES OF I. D. O. FORWARD, TREATED BY SUBCUTANEOUS SECTIONS AND OSTEOTOMY.

CASE CIII. *1819. Weinhold–Swanzig (C. Q.)*[245]. I. D. O. forward (intracoracoid), subcutaneous sections, reduction, result good.

Man, aged 18 years. *Diagnosis:* Intracoracoid dislocation, head under the great pectoral *Duration:* Two and a half months. *Movements*, etc.: ? *Operation:* A fold of skin having been picked up, the external portion was incised transversely to the extent of half a finger's breadth from the insertions of the great pectoral, very forcible extension being kept up. When this was accomplished the wound was increased in length to the extent of nearly a half finger's breadth; immediately the humerus approached near the glenoid cavity, and without any trouble it could be inserted into the cavity and retained in place. *Difficulties and complications of the operation:* None. *Complications after the operation:* None. *Result immediate:* Arm could be moved in all directions. *Result remote:* Three weeks later quite cured. *Remarks:* This is the case of Weinhold; patient came finally into Swanzig's hands.

CASE CIV. *1839. Diffenbach.*[246] I. D. O. forward (subcoracoid), incision of muscles, arthrotomy, reduction, result good.

Man, aged ? years. *Diagnosis:* Subclavicular dislocation; the head has ascended up to near the clavicle, within two inches of the upper extremity of the sternum. *Duration:* Two years. *Movements*, etc.: The arm is scarcely movable; by pulling the arm outward stretches the tendons of the great pectoral, great dorsal, great round, small round, which caused much pain; there was a sense of coldness in the limb; radial pulse is somewhat weaker; limb useless, only the hand could be moved a little. *Operation:* Extension practised by six assistants, with bands fixed upon the wrist; counter extension by six assistants pulling on a towel placed in the axilla to draw the humerus outward. By means of a small knife the muscles are sectioned; the great pectoral is divided near its tendon, the entered axilla and the great dorsal, the great round, and the small round successively cut; entrance made on three sides along the edge of the humerus, and subcutaneous section of the thick false ligaments surrounding the new-formed joint performed; the extension is slacked, the head is rotated repeatedly; extension is reapplied; complete reduction; the shoulder has returned to its natural condition; starch bandage. *Com-*

plications after the operation: None. *Result immediate:* Primary union. *Result remote:* Complete recovery of the movements. *Remarks ?.*

Case CV. *1852. Simon (Gustae.)*[247] I. D. O. forward (coraco-clavicular), subcutaneous tenotomy, reduction, result good.

Female, aged 40 years. *Diagnosis:* coraco-clavicular luxation of right arm. *Duration: ? Movements,* etc.: Atrophy of muscles, great limitation in movements, only forearm could be used. *Operation:* Separation of adhesions about the head of humerus, with a tenotome on three different occasions, first cutting under chloroform, in November, and two more later, the final one on December 22d. *Difficulties and complications of the operation:* None. *Complications after the operation:* None. *Result immediate:* After third procedure patient could raise arm above her head and carry out all movements almost as well as with sound arm. The shoulder was moulded out like the healthy one, coracoid process could be easily felt; subclavicular depression was again reproducd, and almost as broad as a sound side. Complete reduction had taken place, in spite of the fact that the doctor had never noticed head of humerus slip back. *Result remote:* The woman had been in service one month, and did as heavy work as before the accident. Movements possible in every direction; movements somewhat limited backward, and cannot be raised higher than a right angle, and backward cannot extend it so as to button waist-belt of dress. Some crepitation to be felt on passive movement in joint. Musculature of arm has increased, and arm is almost as large as left. *Remarks ?.*

Case CVI. *1882. Polaillon.*[248] I. D. O. forward (intracoracoid), subcutaneous section, reduction, result good.

Male, aged 24 years. *Diagnosis:* Intracoracoid luxation of left shoulder. *Duration:* Four months. *Movements,* etc.: Spontaneous ones very limited. Elevation and rotation outward impossible. Passive movements no more extensive than the active. Muscles of shoulder and arm markedly atrophied. Sensation of almost continual fatigue in arm. *Operation:* First attempt was made to reduce arm by traction, but this failed, and changed the intracoracoid to a subcoracoid luxation; three days later a tenotomy was performed in the following manner: 1st. Drove a tenotome one centimetre below the apex of the acromion, and directed it horizontally from without inward until the head was reached. 2d. Drove a long-blunted tenotome between the anterior surface of the head and the deltoid, and sectioned all the fibrous tissues, cutting against the bone. 3d. The instrument was then

withdrawn slightly, and then driven behind the head, where the fibrous tissues were cut in a similar manner. 4th. This latter procedure can be repeated in other directions. (Delbet, page 149.) *Difficulties and complications of the operation:* None *Complications after the operation:* None. *Result immediate:* Wound healed by first intention. *Result remote:* Six weeks later the movements of the rotation following the axis of the arm are restored. Patient can raise hand to mouth and put it on back of head. He can raise the arm and carry it downward and backward to the lumbar region. Every day movements gain in extent. *Remarks ?.*

Case CVII. *1886. Mollière.*[249] I. D. O. forward (subcoracoid), tenotomy, reduction, result good.

Man, aged 53 years. *Diagnosis:* Subcoracoid luxation. *Duration:* Five weeks. *Movements*, etc.: Head very firmly fixed under coracoid process. *Operation:* Tenotomy, subcutaneous, of all the cicatricial bands which filled the glenoid cavity; knife introduced through deltoid or about the middle. Head then easily reduced by rotation. *Difficulties and complications of the operation:* None. *Complications after the operation:* None. *Result immediate:* No reaction. *Result remote:* Movements of arm completely re-established. *Remarks:* The head was firmly fixed under the coracoid process.

Case CVIII. *1876. Mears* (*J. Ewing*).[250] I. D. O. forward (subcoracoid), subcutaneous, osteotomy, result fair at first, but not so good later.

Man, aged 38 years. *Diagnosis:* Arm markedly projected from side of the body and extended, elbow drawn backward, and forearm in a state midway between supination and pronation. Head of humerus was found to be fixed in its acquired position by adhesions. *Duration: ? Movements*, etc.: Patient unable to place the hand on opposite shoulder; when the arm was approximated to the side of the body could introduce hand into pantaloons-pocket by great effort, but hip-pocket could not be reached; pain. *Operation:* Subcutaneous division as practised by Mr. Adams; knife carried flatwise through the tissues, on the outer aspect of the arm, two inches below the acromion process, directly to the bone, position of the blade changed, and the periosteum divided by incisions carefully made, the edge of the knife being kept closely in contact with the bone. Knife having been withdrawn in the same manner as introduced, the saw was passed flatwise through the opening to the bone, bone divided by very short "higgling" movements, time required to sever it being five minutes.

When section was completed, the fragments were separated, the lower one being thrown backward and outward, and the arm was placed in the Velpeau position and secured by bandages. *Difficulties and complications of the operation:* None. *Complications after the operation:* None. *Result immediate:* Wound closed in three days without suppuration. *Result remote:* At the expiration of ten days the arm was released, and passive motion was instituted. Three months after operation arm hung naturally by the side, no apparent difference in length of two limbs; natural in size and contour, muscles firm, and atrophy of the deltoid in a great measure disappeared. Rotation of the arm could be performed without causing pain and without moving the upper fragment. When lower fragment was forced up and rotated, slight crepitus could be elicited. Hand could be placed on opposite shoulder, into pantaloons- and hip-pocket, watch could be taken readily from vest-pocket; patient could raise a sixteen pound weight by the pulley, at which exercise he practised daily, gradually increasing the weight. Careful examination nine months later showed the false joint which had been formed every way satisfactory. Later much stiffness and callus occurred, and the limb was not useful. *Remarks:* Efforts at reduction were made prior to operation.

HISTORIES OF I. D. O. DOWNWARD TREATED THROUGH AXILLARY INCISION BY RESECTION.

CASE CIX. *1877. Langenbeck.*[351] I. D. O. downward (axillary ?), axillary incision, resection, result (?).

Man, aged ? years. *Diagnosis:* Axillary dislocation; marked projection of the head; the artery is pressed downward and inward. *Duration:* ? *Movements*, etc.: ? *Operation:* Longitudinal incision along the inner border of the coraco-brachial, head projects through incision; resection of the head. *Difficulties and complications of the operation:* None. *Complications after the operation:* ? *Result immediate:* Wound healed on the seventeenth day. *Result remote:* ? *Remarks* ?.

CASE CX. *1879. Patterson.*[352] I. D. O. downward (subglenoid), axillary incision (?), reduction, result ?.

Man, aged 59 years. *Diagnosis:* Subglenoid (axillary). *Duration:* Eleven weeks. *Movements*, etc.: Partial paralysis; arm and hand cold and swollen. *Operation:* Incision (?), reduction not effected; resection. *Difficulties and complications of the operation:* None. *Complications after the operation:* ? *Result immediate:* ? *Result remote:* ?

CASE CXI. *1885. Thomas (of Tours).*[253] I. D. O. forward (subglenoid), axillary incision, resection, result improved.

Man, aged 45 years. *Diagnosis:* Subglenoid dislocation, axillary. *Duration:* Forty-four days. *Movements*, etc.: ? *Operation:* Incision through axilla. *Difficulties and complications of the operation:* The operation was long and tedious, great difficulty in freeing the head; it had to be sectioned by successive slices. *Complications after the operation:* Suppuration. *Result immediate:* Wound closed at the end of the second month. *Result remote:* Three months after the operation the patient had use of his hand and forearm, passive motion being possible without pain; the arm could be raised to a right angle, carried forward and backward, and some rotation was possible. Nine months after the operation, the patient having failed to use his arm according to directions, there was anchylosis of the shoulder and stiffness of the elbow, with incomplete extension of the forearm; there was also an excessive growth of bone taking the place of the head. Taking in consideration his former state, the patient was, however, satisfied. *Remarks* ?.

HISTORY OF A CASE OF I. D. O. DOWNWARD TREATED BY OSTEOCLASIA.

CASE CXII. *1879. Desprès.*[254] I. D. O. forward (subglenoid), deliberate fracture, result bad.

Woman, aged 53 years. *Diagnosis:* Subcoracoid, dislocated for the second time. *Duration:* ? *Movements*, etc. ? *Operation:* Deliberate fracture of the neck so as to be able to bring the arm close to the body. The forced elevation of the arm causing it to press against the acromio-coracoid vault, determined the fracture; a crackling sound was heard, crepitation was felt. *Difficulties and complications of the operation:* None. *Complications after the operation:* A callus formed, and it was impossible to obtain a false joint. *Result immediate:* Failure. *Result remote:* Same. *Remarks:* None.

HISTORIES OF CASES OF I. D. O. BACKWARD TREATED BY RESECTION.

CASE CXIII. *1877. Reid.*[255] I. D. O. backward (post-glenoid), in the adult, resection, improved.

Man, aged 53 years. *Diagnosis:* Posterior glenoid dislocation. *Duration:* Three months. *Movements*, etc.: The arm is fixed in a

position forward and outward: abduction impossible; a maximum of motion forward and backward; elongation of the arm two centimetres. *Operation:* Incision in the direction of the axis of the humerus beginning at the spine of the scapula or the back of the shoulder, eight centimetres long, and curved parallel with the posterior border of the deltoid; the muscles attached to the tuberosities, together with the periosteum, were separated from the bone and the head freed and sawn through at the surgical neck. *Difficulties and complications of the operation:* None. *Complications after the operation:* None. *Result immediate* ?. *Result remote:* At the discharge of the patient three months later motion of the arm was seemingly free forward and backward, while active abduction was limited and passive abduction possible to the horizontal, the arm being quite useful by means of systematic exercises. *Remarks* ?.

Case CXIV. *1888. Adams.*[256] I. D. O. backward, resection, result good.

Man, ? years old. *Diagnosis:* Dislocation backward. *Duration:* Two years. *Movements*, etc.: Atrophy of the muscles of the shoulder; inability to use the arm. *Operation:* Incision (?), resection close below the surgical neck. *Difficulties and complications of the operation:* ? *Complications after the operation:* ? *Result immediate:* ? *Result remote:* One year after the patient was able to do light work as a railroad porter. *Remarks* ?.

Case CXV. *1896. Brinton (J. H.).*[257] I. D. O. backward (subspinous), with fracture of head below tuberosities; V-incision over deltoid, resection, result satisfactory.

Man, aged 30 years. *Diagnosis:* By x-rays, head of humerus showed dislocation, with some bony attachment to upper part of infraspinous fossa and apparent transverse fracture of humerus just below tuberosities. *Duration:* Three months. *Movements*, etc.: No motion at head of bone. *Operation:* V-flap over deltoid; breaking down of adhesions with chisel; line of fracture irregularly transverse and just below the tuberosities; head of humerus with tuberosities removed down to the line of fracture; upper end of fragment smoothed; humerus brought into position, deltoid fibres drawn together by buried gut sutures and superficial fascia and skin by silkworm-gut sutures; drainage. *Difficulties and complications of the operation:* ? *Result immediate:* Primary union. *Result remote:* Satisfactory motion at false joint. *Remarks.* ?

HISTORIES OF CASES OF I. D. O. CONGENITAL, TREATED BY REDUCTION AND BY RESECTION.

CASE CXVI. *1882. Kuster.*[258] I. D. O. congenital, backward, reduction, death.

Sex ?, aged ? years. *Diagnosis:* Backward luxation, congenital of both shoulders. *Duration:* Fourteen months. *Movements*, etc.: Left arm is turned inward so that the olecranon pointed forward and upward, and gave the arm the appearance of having been completely turned once on its long axis. Fingers were permanently flexed, and could not be entirely straightened passively. The right arm and hand presented just the same appearance, but not to so great an extent. *Operation:* Head of the humerus freed, brought forward and rotated. Drainage and carbolic dressing. *Difficulties and complications of the operation* ?. *Complications after the operation:* Fever and suppuration. *Result immediate:* Wound did not heal. *Result remote:* Child died, about one month after operation, of vomiting and diarrhœa. *Remarks:* Author considered condition to be somewhat similar to congenital hip dislocation, and that dislocation was probably due to deficiency in development of glenoid cavity. At the post-mortem the right shoulder was opened; after cutting through the skin and fascia the capsule was seen drawn over head of humerus, which presented itself to the posterior lower edge of the atrophied deltoid. When capsule was opened the shoulder could not be reduced, because head was rotated so far inward that the greater tubercle, which was covered by the capsule, laid within the glenoid cavity. This cavity was small, very shallow and convex in its anterior half; in the posterior half irregularly enlarged and deepened. Left cavity showed similar conditions. Cartilage on head and in cavity partially destroyed.

CASE CXVII. *1892. Schede.*[259] I. D. O. congenital, backward, arthrotomy, reduction, necrotic fragments, result good.

Female, aged 8 years. *Diagnosis:* Congenital infraspinous luxation of right shoulder. *Duration:* Since birth, eight years. *Movements*, etc.: Much limited, and carried out with little power, abduction very slight, elevation in a horizontal position almost impossible. *Operation:* Incision downward in the axis of the arm one centimetre inside the outer edge of the acromion. *Difficulties and complications of the operation:* Capsule split, and incisions made into it both in front and behind. Glenoid cavity enlarged and deepened. Part of capsule in front removed, and the posterior portion freed from the glenoid cavity

and drawn forward so as to cover the head. Dislocation reduced, wound closed without drainage; the tendon of the biceps was cut through by accident; it did not run over the head but on the inner side and posteriorly. The glenoid cavity was divided into a surface with two facets by a ridge running vertically, the anterior of these two facets was very shallow and small, and corresponded to the normal glenoid cavity, the posterior was much larger, and belonged to the pathologically formed joint. Both facets lay within a common capsule, which, however, in its anterior part offered much too little space to receive the head. The head had lost its round form, with marked flattening of the anterior surface, which articulated with the new joint cavity, which faced backward and outward. The anterior facet was enlarged until it could receive the head. "The head, together with the capsule, was replaced." The coronoid process, which had developed quite abnormally in form and direction, and had become larger and more crooked than normal, and bridged over the inner portion of the normal joint surface in such way as to prevent reduction, was separated partially at its base by an osteotomy, and broken so far backward that it no longer prevented reduction. *Complications after the operation:* Four days later there was suppuration, and a drain had to be put in. All went well for some days, then again rise in temperature. The patient was anæsthetized and wound sounded. The greater tubercle was found to be necrotic and removed. Joint washed out with corrosive sublimate and done up antiseptically. *Result immediate:* Healed slowly. *Result remote:* Two months after primary operations all movements were smooth and free, both passive except for elevation. Done passively, this was almost normal; actively, not above 45°. *Remarks:* The luxation was congenital and intrapartum, as was proved by the doctor who attended the mother's confinement.

Case CXVIII. *1897. Brown* (*Tilden*).[260] I. D. O. congenital, backward, reduction, result good.

Male, aged ? years. Accouchement and delivery took place in thirty-six hours, without aid; was noticed within at least a few hours after birth. *Diagnosis:* Backward dislocation, head a little below and under the acromion. *Duration:* Child was several months old when operated. *Movements*, etc.: Arm hung at the side and movement caused pain; wrist and fingers partly closed; elbow could be closed with little force. *Operation:* Cut down upon the joint over deltoid posteriorly; on rotating the arm the head snapped into the glenoid cavity.

Difficulties and complications of the operation: None. *Complications after the operation:* None. *Result immediate:* Healed mildly. *Result remote:* Still some spasmodic flexion of the hand. *Remarks?*.

CASE CXIX. *1861. Post (Alfred C.).*[261] I. D. O. congenital, backward dislocation, fibrous anchylosis of the dislocated head, resection, result not stated.

Female, aged 8 years. *Diagnosis:* Dislocation of head of humerus, with fibrous anchylosis; head on dorsum scapula. *Duration:* Injured during birth of the child, and deformed ever since. *Movements*, etc.: Nutrition of limb defective; innervation much impaired, so that the patient can exert but little power in its movements. *Operation:* Longitudinal incision made near the posterior edge of the deltoid, dividing the fibres of that muscle, and exposing the head of the bone, which was found to be dislocated on the dorsum scapula; capsule divided, and extremity of the bone turned out. A leaden spatula was passed beneath the bone to protect the soft parts; exsection of upper extremity of bone; a portion of the bone, about three-fourths of an inch, was removed with saw; on examining the limb and moving it in different directions it was thought best to remove an additional piece of bone, this second portion as nearly as long as the first; hand then brought forward across anterior part of the chest, where it lay in an easy position, without apparent deformity. Edges of the wound brought together by means of eight twisted sutures made with insect pins. *Difficulties and complications of the operation:* None. *Complications after the operation:* None. *Result immediate:* Not stated. *Result remote:* Not stated.

CASE CXX. *1897. Phelps (A. M.) No. 1.*[262] I. D. O. congenital, backward (subspinous), resection, result very good.

Boy, aged 8 or 9 years. *Diagnosis:* Subspinous dislocation, the head is backward of the glenoid cavity. *Duration:* Congenital; according to the statement of the parents, the trouble with the arm had existed since birth; labor had been instrumental; it was discovered after birth, and the doctor suggested that it be left until the child got older; other physicians and surgeons had since seen the boy and were of the opinion that an operation was not advisable (*Medical Record*, September 21, 1895) *Movements*, etc.: A physician pronounced the case one of paralysis; all the movements of the arm interfered with, especially in placing the arm across the chest; the hand could not be carried to the mouth; movements of the humerus are accompanied

by movements of the scapula; the whole arm is rotated inward, the palm turned backward; the elbow protruded a little from the side of the chest; the head of the humerus presented a bony prominence below the spine of the scapula. Flexion and extension of the forearm were weak, pronation and supination were normal. *Operation:* Curved incision along the lower edge of the deltoid and on to the scapula, and flap turned down; it would be best to curve the incision downward and turn the flap upward, as it would give better drainage. *Difficulties and complications of the operation:* The posterior edge of the glenoid cavity was gone and the cavity was about two-thirds the normal size; a portion of the head of the humerus was cut away in order to fit it to the socket; also cut away a portion of the redundant capsule posteriorly; the bone replaced and a stitch put in behind to help retain the head in place. *Complications after the operation:* None. *Result immediate:* Drainage-tube left a week. *Result remote:* Is satisfactory. Dr. A. P. Dudley saw the patient a year after the operation, and there was little difference between the two arms. *Remarks:* Dr. Dudley did not doubt that the injury had occurred during delivery. Doctors who had seen the patient before were of the opinion that it was one of paralysis. Dr. A. M. Phelps says that the method promised success during the first year, although one case has been operated in which it was successful at the fifth year.

Case CXXI. *1897. Phelps (A. M.),*[263] *No. 2.* Congenital, backward (subspinous), result fair.

Boy, aged ? years. *Diagnosis:* Subspinous dislocation. *Duration:* Congenital. *Movements*, etc.: A neurologist had found the reaction of degeneration, which seemed to be due to some pressure neurosis. *Operation: ? Difficulties and complications of the operation: ? Complications after the operation: ?. Result immediate:* Suppuration due to catgut, which necessitated a counter-opening. *Result remote:* As a result of the scars motion was not so complete as it might have otherwise become; the reaction of degeneration disappeared. *Remarks: ?.*

HISTORIES OF I. D. O. RECURRENT OR HABITUAL.

Case CXXII. *1892. Ricard, No. 1.*[264] I. D. O. recurrent, forward, anterior incision, stitching of capsule (reefing), result good.

Man, aged ? years. *Diagnosis: ?* Dislocates his shoulder on very slight occasions. *Duration: Movements*, etc.: ? *Operation:* An in-

cision about twelve centimetres long on the pectoro-deltoid interstice; at the upper end the incision is prolonged at a right angle by following the contour of the insertion of the deltoid on the clavicle and acromion. The deltoid is detached in its entire extent from the incision and turned outward and backward. The coraco-brachialis is then lifted by an assistant so as to disclose the subscapular muscle at its humeral insertion. The operator frees the upper and inferior edges of this muscle so as to freely expose the capsule. The arm is then rotated forcibly; in this way the anterior wall of the capsule is relieved of tension. Then, at the top of this wall, through the capsule and into the thickness of the subscapular muscle, Ricard passes three stitches of coarse flat silk, vertically directed, and about two centimetres one from the other. The free extremities of these threads are tied (*deux à deux*) in order to reduce this anterior wall to the least, but most, resistant and rigid thickness. In front of its interline, after the constriction of the threads, is found a resistant surface which the fingers cannot depress. It is essential that during this time the arm should be forcibly carried inward. After hæmostasis the insertions of the deltoid are restored with catgut; then follows suture of skin without drainage? *Difficulties and complications of the operation: ? Complications after the operation: ? Result immediate: ? Result remote:* In the nine months following the operation, when he was employed wheeling a wheelbarrow, he had not dislocated his shoulder. *Remarks: ?* These cases were reported by Ricard at the Académie de Médécine, at the meeting on October 31, 1892; but in the *Transactions* of the society (*Bulletin de l'Académie de Médécine*, 1892, 3d Series, vol. xxviii.), under this date, there is only a note of three lines, to the effect that he reported these cases. As reported in the *Gazette des Hôpitaux*, they come under the society meetings, and so are given only in abstract form. No other reference to these cases has been found.

Case CXXIII. *1892. Ricard,*[365] *No. 2.* I. D. O. recurrent, forward, anterior incision, stitching of capsule (reefing), result good.

Man, aged ? years. *Diagnosis:* Dislocated his shoulder on slight effort or during epileptic attacks; reduction was often difficult, and required anæsthetic. *Duration: ? Movements*, etc.: ? *Operation:* Same as foregoing. *Difficulties and complications of the operation: ? Complications after the operation: ? Result immediate: ? Result remote:* Luxation had not occurred in three months after the operation, although the patient had had epileptic attacks. *Remarks: ?.*

CASE CXXIV. *1898. Samosch (J.).*[266] I. D. O. recurrent, forward incision, lapping, stitching, result good.

Male, aged 38 years. *Diagnosis:* Dislocation of right shoulder. *Duration:* Indefinite; first injury ten years before operation. *Operation:* Joint laid open according to the incision of Ollier-Huter. It was necessary to ligate the vena cephalica. The only pathological condition was a relaxation or stretching of capsule of joint in such a manner that both anteriorly and internally there was a considerable distention, like a hernial sac, into which the head of the humerus could sink. In order to diminish the size of the capsule the distended portion of the capsule was split in a perpendicular direction throughout its entire length. The medial portion of this distention was drawn over the lateral, then pulled strongly forward and laterally, and in this position was sewn with four buried silver stitches to the outer wall of the median portion of the capsule. After careful stopping of hemorrhage, the cavity of the wound was tamponed. *Result immediate:* Wound healed without suppuration. *Result remote:* Weeks after the operation, when patient was discharged, he could swing a weight of two kilogrammes around in a circle, and he could raise a weight of four kilogrammes horizontally without use of scapula. *Remarks:* Operation was undertaken because of frequency of dislocation. It had occurred twenty times or more. It had been at first replaced by doctors, but finally patient learned to do it for himself. When first seen at the clinic the arm was not dislocated, but it was very easy to do this.

CASE CXXV. *1884. Gerster.*[267] I. D. O. recurrent, forward (subcoracoid), resection of part of capsule, stitching, result fair.

Female, aged 20 years. *Diagnosis:* Subcoracoid dislocation of the humerus. *Duration:* Seven weeks. *Movements*, etc.: Paralysis of serratus magnus. *Operation:* Reduction did not offer the least difficulty, but the weight of the extremity alone was sufficient to cause the reappearance of the dislocation. The reduced humerus was kept in normal position five weeks by means of an ample plaster-of-Paris dressing enveloping the arm, shoulder, and thorax. When removed reappearance of dislocation; hence, arthrotomy by the anterior incision was performed. It was found that the inner aspect of the joint capsule, the side facing the axilla, was abnormally relaxed, and, therefore, a piece one inch long and two inches wide was excised from it while the arm was forcibly rotated outward. A counter incision was made

into the posterior part of the capsule for drainage, and capillary drainage by a fascicle of catgut strands was established. The anterior wound was closed by sutures. *Complications after the operation:* Six hours after the operation very alarming septic fever set in, temperature 103° F., great sickness and dejection. Wound opened; among the seven catgut ligatures there was found one much thickened, turbid, and infiltrated with and surrounded by pus. The remainder of the wound was found to be normal, the rest of the ligatures being slightly thickened, not transparent. The fascicle was removed and replaced by a rubber drainage-tube. Wound treated openly, temperature fell to normal, and the case progressed favorably. *Result immediate:* Tube removed at second week, wound healed in eight weeks. Healing was retarded by an attack of erysipelas commencing from the opening made for the drainage-tube at a time when healing was nearly complete. *Result remote:* The function of the joint was now fair, and promised to improve and become normal, since its mobility was considerable now, although very little orthopedic treatment has been employed. *Remarks* ?.

Case CXXVI. *1897. Burrell (H. L.), No. 1.*[268] I. D. O. recurrent, forward (subcoracoid), anterior incision, resection of part of capsule, result good.

Man, aged 27 years. *Diagnosis:* Forward dislocation. *Duration:* ?. *Movements*, etc.: ?. *Operation:* An incision was made over the deltoid muscle, beginning at its insertion and extending up about six inches. The fibres of the deltoid were separated and three-fourths of the tendon of the insertion of the pectoralis major was slit down to permit access to the joint. The capsule of the joint was found intact, but very loose. From the inner and anterior aspect of the capsule a piece was removed four centimetres long and one centimetre broad. This opened the joint. It was explored, and as far as could be felt was normal. The capsule was closed by catgut sutures, and the wound was closed by silkworm-gut sutures. A sterile dressing was applied, the arm being put up with the forearm flexed and the point of the elbow raised and carried inward toward the median line. *Difficulties and complications of the operation:* ?. *Result immediate:* There was considerable pain after the operation, but it was controlled by morphia; aseptic healing occurred. The arm was dressed and all sutures removed in eighteen days, but the arm was restrained by a Velpeau bandage. Massage was carried out in this

case for four weeks. *Result remote:* The patient returned to his full work at the end of eight weeks from the time of the operation (Burrell, page 16).

Case CXXVII. *1896. Burrell (H. L.), No. 2.*[269] I. D. O. recurrent, forward, subcoracoid (?), anterior incision, resection of capsule in part, result good.

Man, well developed, of ordinary height; aged 36 years. *Diagnosis:* Forward (subcoracoid dislocation ?). *Duration:* ?. *Movements*, etc.: ?. *Operation:* Same as above. *Difficulties and complications of the operation:* ?. *Complications after the operation:* ?. *Result immediate:* ?. *Result remote:* ?. *Remarks* ?.

Case CXXVIII. *1888. Albert (E.).*[270] I. D. O. recurrent, forward (?), posterior incision, arthrotomy, reduction and stitching of head, result anchylosis.

Female, aged 19 years. *Diagnosis:* No mention of the sort of dislocation. *Duration:* About sixteen months. *Movements*, etc.: Slight crepitation in rotation; power of arm much diminished. *Operation:* A cut six centimetres long was made on the posterior side of the joint, along course of fibres of the infraspinatus muscle. The other muscles which had to be cut through were also severed in the course of their fibres, and edges held apart with hooks, the glenoid cavity was freed of its cartilaginous covering with a curved chisel, and then the head of the humerus was made to fit the cavity, by freeing it of its cartilage and shaving the head quite smooth. Then a stitch of kangaroo-gut was passed through the head and the edge of the cavity. A strip of iodoform gauze was passed through the muscles into the joint, the wound was put up with a sublimate dressing, and the arm firmly fixed with a stiff bandage, in a position of flexion. *Difficulties and complications of the operation:* The posterior wall of the capsule about the joint showed itself much thicker than normal, and much of it had to be cut away with the scissors. *Complications after the operation:* None. *Result immediate:* Healing by first intention. *Result remote:* Ankylosis in the joint. *Remarks:* The shoulder had slipped out of joint and been replaced nine times between February, 1896, and June, 1897; it would slip out on very slight causes, as, for instance, when putting on a dress in raising her arm.

Case CXXIX. *1882. Cramer.*[271] I. D. O. recurrent (subcoracoid), anterior incision, resection, result fair.

Female, aged 30 years. *Diagnosis:* Subcoracoid dislocation. *Dura-*

tion: About five years since first dislocation; patient was an epileptic, and had dislocated shoulder nineteen times in last five years. It could be easily reduced, but could not be kept in place. Operation was decided upon because of the distress she experienced from these frequent dislocations and inability to work. *Movements*, etc.: Pain and swelling of arm, atrophy of shoulder. *Operation:* Six centimetres of head of humerus resected according to Langenbeck's method (?), capsule found stretched, and no apparent tear in it. *Difficulties and complications of the operation:* None. *Complications after the operation:* None. *Result immediate:* Wound healed by first intention. *Result remote:* Five months after operation passive movements can all be carried out without difficulty, and action still much limited. Elevation to a horizontal line not possible, and only then by means of shoulder-blade. Patient can touch her mouth, but eating is difficult, and also top of head and back of neck, and can dress her hair, but she still has pains in arm at times. She can do all housework, like washing, cooking, etc. Shoulder is still atrophied. Result only fair. *Remarks* ?.

Case CXXX *1882. Popke.*[272] I. D. O. recurrent, anterior incision, resection, result improved.

Male, aged 30 years. *Diagnosis:* Luxation of left shoulder (habitual), *Duration:* Six years. *Movements*, etc.: ? *Operation:* Resection with anterior incision; capsule showed no tear, so was split in ordinary manner. *Difficulties and complications of the operation:* ? *Complications after the operation:* Stitch abscess and slight necrosis at end of humerus. *Result immediate:* Healed slowly. *Result remote:* Patient discharged at the end of six weeks with arm in good position. Patient later informed surgeon by letter that as far as use of arm was concerned he was much better satisfied than before the operation. *Remarks:* Patient was an epileptic, and arm could not be kept in position by any bandage. It easily slipped out of place, and was easily reduced, though this could not be done at time of operation, when patient was under chloroform; at operation the following conditions were observed; behind, on the head of the humerns, the cartilage was absent over an area one-third of head; the half-moon shaped surface, which is smooth and free of cartilage, is undoubtedly due to the breaking off of a wedge-shaped piece of bone from the head; but this piece was not to be found in the wound, and had probably been absorbed. The joint surface of the scapula was also deformed, so that it was no longer as normal, broader below than above, but had a more oval shape, so that it was broader

above than below. The capsule had been torn off from the whole lower and inner portion of the deformed glenoid cavity, so that there was an opening present which led into the subscapular bursa. The edge of the capsule about this opening was irregularly thickened, and to it was attached a hard bony body, about the size of a pea, covered with cartilage, evidently the remnant of a fragment, which at the time of the injury had been broken off with the capsule from the joint surface of the scapula.

Case CXXXI. *1883. Sacré.*[273] I. D. O. recurrent (subcoracoid), anterior incision, resection, result good.

Female, aged 26 years. *Diagnosis:* Incomplete subcoracoid luxation of left shoulder. *Duration:* Six months. *Movements*, etc.: Voluntary ones are very limited and so painful that limb is held absolutely motionless. Abduction impossible. Pain is constant. Passive movements cause patient to cry. *Operation:* A vertical incision slightly posterior to coracoid process and extending to the point of the deltoid. Skin, deltoid, and articular capsule divided. Resection of head of humerus at surgical neck. Drain at lower angle of wound, which is elsewhere sewed up with catgut. Antiseptic dressing. Desault bandage. *Difficulties and complications of the operation:* None. *Complications after the operation:* None. *Result immediate:* Wound healed completely two weeks after operation. *Result remote:* When seen three months later all movements of the joint could be carried out without pain, except abduction, which was impossible because of the paralysis and atrophy of the deltoid. Could put hand on forehead and backward on the lumbar region. *Remarks:* The arm could be easily reduced at time of operation, but would not stay in place, slipping out immediately. At time of operation the joint was found quite normal, there was no change in the articular surface, and the fibrous capsule was not torn.

Case CXXXII. *1893. Owens (No. 2.)*[274] I. D. O. recurrent, forward, anterior incision, resection, result fair.

Male, aged 25 years. *Diagnosis:* Subcoracoid, frequently recurring dislocation. *Duration:* Five years ago first dislocation from epileptic fits, since then it has happpened nearly twenty times, and reduced under chloroform. *Movements*, etc.: Not stated *Operation:* Being under anæsthetic, a little manipulation easily produced a subcoracoid dislocation, which could be as easily reduced. The head of the bone with the tuberosities was resected, and when this was done the rent in

the capsule by which the bone was accustomed to make its exit was seen and recognized. *Difficulties and complications of the operation:* ? *Complications after the operation:* ? *Result immediate:* Wound healed at once, beginning of third week gentle movements were begun. *Result remote:* He now has fair use of the arm, and all promises well for its future usefulness, with no recurrence of his old trouble. *Remarks* ?.

CASE CXXXIII. *1896. Monks (G. H.)*[275] I. D. O. recurrent, forward (subcoracoid), anterior incision, resection, improved.

Man, aged 57 years. *Diagnosis:* Subcoracoid dislocation. *Duration:* Ten months. *Movements*, etc.: Atrophy of all the muscles about the shoulder, arm, forearm, and hand; patient's grasp very weak; voluntary movements extremely limited; complete ulnar paralysis, also partially of the median, musculo-spiralis, circumflex; says he has been daily losing power in his arm up to the time he entered the hospital, when he stated it was about useless. *Operation:* Incision in the anterior margin of the deltoid; section of the supraspinous, infraspinous, small round, subscapular; long tendon of the biceps dislocated from its groove, but not divided. *Difficulties and complications of the operation:* None. *Complications after the operation:* None. *Result immediate:* Primary union. *Result remote:* Can use arm to a far greater degree and with a much greater range of motions than was possible before the operation, condition of the nerves also improved considerably. Left the hospital, and no further account of him. *Remarks:* The head of the bone was very much atrophied, and on being removed it could be easily crushed in the bone forceps, showing that had an attempt been made to reduce the dislocation by manipulations a fracture would probably have taken place at the neck of the bone, thus adding a new complication.

BIBLIOGRAPHY.

1. Knapp, O. Ueber die operative Behandlung irreponibler traumatischen Luxationen des Schultergelenks. Beiträge, 1889, Bd. iv. p. 382.

2. Smital, Frank. Wiener Medicinische Wochenschrift, 1890 (40), 2251; 1891 (41), 6, 65.

3*a*. Delbet, Pierre. Archives Générales de Médecine. Paris, 1893, vol. i. pp. 19–144.

3*b*. McBurney, Charles. Dislocation of the Humerus Complicated by Fracture at or near the Surgical Neck, with a New Method of Reduction. Annals of Surgery, Philadelphia, April, 1894.

4. Post, cited by Ollier. Traité des Résections et des Opérations conservatives qu'on peut pratique sur le Système Osseux. Paris, 1888, Masson, ii. See reference, No. 262.

5. Warren, cited by Ollier. Idem. See reference, No. 185.

6. Dechambre. Dictionary, p. 728.
7. Stimson, L. A. Dislocations, p. 259.
8. Stimson. Private communication. New York, May 14, 1897.
9. McBurney. Op. cit., p. 4. 10. p. 4. 11. p. 5. 12. p. 5. 13. p. 5. 14. p. 7. 15. p. 6. 16. p. 6. 17. p. 7. 18. p. 7. 19. p. 8. 20. p. 8. 21. p. 8. 22. p. 13.
23. Stimson, L. A. New York Medical Journal, Sept. 20, 1890, p. 328.
24. Parmenter, John. Buffalo Medical and Surgical Journal, July, 1891.
25. Keener, W. New York Medical Journal, 1894, vol. lx. p. 719.
26. Wyeth, John A. Private communication. New York, October 29, 1895.
27. Stemen, C. B. Journal of the Medical Sciences, Fort Wayne, Ind., October, 1893, vol. xiii., No. 10, p. 170.
28. Idem.
29. Porter, Chas. B. Transactions American Surgical Association, vol. xii. p. 287. Also Records of Massachusetts General Hospital, Boston, Mass.
30. McBurney, Charles. Op. cit., p. 8.
31. Porter, Chas. B. Private communication. Boston, May, 1897. Also Records of Massachusetts General Hospital, Boston, Mass.
32. Berger, P. Arthrotomie pour une luxation compliquée de fracture de l'extrémité supérieure de l'humérus. Bulletins et Mémoires de la Société de Chirurgie de Paris, 1896, vol. xxii., No. 3, p. 215.
33. McBurney, Charles. Annals of Surgery, Philadelphia, May, 1896.
34. Bull, W. T. Annals of Surgery, Philadelphia, March, 1897.
35. Tripier. Congrès Français de Chirurgie. Procès Verbaux, 1886, vol. ii. p. 326. Paris, 1887.
36. Wolfler, cited by McCormac. Congrès Français de Chirurgie. Procès Verbaux, 1893, vol. vii. p. 384.
37. Morton, Thos. G. American Journal of the Medical Sciences, 1884, vol. lxxxvii. p. 173.
38. Mauclair. Bulletin de la Société Anatomique de Paris, 1889, p. 513.
39. Watson-McLauren. Edinburgh Medical and Surgical Journal, 1889, p. 11.
40. Croft. London Lancet, March 29, 1891.
41. Poirier and Mauclair. Revue de Chirurgie, October, 1892, Case V., pp. 849–850.
42. Clutton, N. H. Transactions Pathological Society, London, 1892, vol. xliv. No. 3, p. 128.
43. Monks, G. H. Private communication. Boston, March 11, 1895. Also Boston Medical and Surgical Journal, February 6, 1896.
44. McGraw, Th. A. Private communication. Detroit, March, 1897.
45. Brinton, J. H. Private communication. The case is to be published in Dunglison's College and Clinical Record for June, 1897; now in press.
46. Delbet, Pierre. Op. cit., p. 27.
47. Delbet. Op. cit., p. 27.
48. Delbet. Op. cit., p. 27.
49. Kocher, Th. Deutsche Zeitsch. f. Chirurgie, 1890, p. 423; cited by Delbet, op. cit., p. 27.
50. Delbet. Op. cit., p. 27. 51. p. 27. 52. p. 29. 53. p. 27. 54. p. 31.
55. Lund, F. B.
56. Delbet. Op. cit., p. 33. 57. p. 35. 58. p. 38. 59. p. 35. 60. p. 35. 61. p. 37. 62. p. 37. 63. p. 38. 64. p. 39. 65. p. 145. 66. p. 146. 67. p. 152. 68. p. 152. 69. p. 153. 70. p. 153. 71. p. 153. 72. p. 153.

73. Smital. Op. cit.

74. Idem.

75. Delbet. Op. cit., p. 158.

76. Ollier. Traité des Résections et des Opérations conservatives qu'on peut pratique sur le Système Osseux. Paris, 1888, Masson, ii. p. 14.

77. Idem, p. 32.

78. Wolff, J. Berliner klinische Wochenschrift, 1886, pp. 897–903. Ueber einen Fall von Schultergelenks arthrodese wiegen eines duch traumatische myopathie enstaudlinen Schultergelenks. Also Centralblatt für Chirg., 1887, vol. xv. p. 627.

79. Burrell, H. L. Transactions American Surgical Association, 1897.

80–89. Idem. 90. p. 8.

91. Ollier. Op. cit., p. 91.

92. Lücke. Beiträge z. Liber V., die Resect., 1862. Archiv f. Chirurgie. Also Ollier, op. cit., p. 91.

93. Ollier. Op. cit.

94. Souchon, Edmond. Operative Treatment of Anchylosis of the Shoulder-joint. Transactions American Surgical Association, 1896. Also Annals of Surgery, Philadelphia, October, 1896.

95. Lagrange, Felix. In Dechambre's Dictionary, article Epaule, p. 754.

96. Idem, p. 754.

97. Ollier. Op. cit., p. 5. 98. Op. cit. 99. p. 9. 100. p. 10. 101. p. 11. 102. p. 12. 103. p. 13.

104. Longmore. Resection of Shoulder-joint in Military Surgery, p. 12. Also Jacobson, Surgical Operations, p. 126.

105. Erichsen. Surgery, vol. ii. p. 250. Also Jacobson, op. cit., p. 12.

106. Ollier. Op. cit., pp. 15–16. 107. p. 23. 108. p. 14.

109. Jacobson. Op. cit., p. 135.

110. Lister. Case of 1873.

111. Delbet. Op. cit., p. 158.

112. Delbet. P. 158.

113. Ollier. Op. cit.

114. Smital. Op. cit.

115. Ollier. P. 68.

116. Ollier. Pp. 84, 86, 88, 97.

117. Jacobson. Op. cit., p. 126.

118. Ollier. Op. cit., p. 19. 119. p. 20. 120. p. 30. 121. p. 32. 122. p. 91. 123. p. 32. 124. p. 32. 125 p. 32. 126. p. 33. 127. p. 33. 128. p. 33. 129. p. 33. 130. p. 35. 131. p. 34. 132. p. 5. 133–137. p. 93. 138. p. 125. 139. p. 84. 140. p. 91.

141. Dechambre. Op. cit., p. 758.

142. Ollier. Op. cit., pp. 84, 86, 88, 97.

143. Wattmann. Uebersicht der Ereignisse auf der Chirurgischen Klinik zu Innsbruck, 1818–1824.

144. Lister, J., 1873. Edinburgh Medical and Surgical Journal, March, 1873. Also in Hinsel. Also London Lancet, January 4, 1890.

145. Lister, 1873. Idem.

146. Albert, 1874. Lehrbuch der Chir., S. 319, Bd. ii. Also O. Knapp. Also in Hamilton on Dislocations, 1891, p. 587.

147. Buckhardt, H., 1878. Medicinisches Correspondenz Blatt des Würtembergischen Aerztlichen Vereins, 1877–1878, Bd. xlviii., No. 4, p. 25. Also O. Knapp.

148. Albert, 1878. Lehrbuch der Chirurgie. Also in Rosemeyer. Also in O. Knapp.

149. Socin, 1885. Jahresbericht ueber die Chirurgische Abteilung des Spitals uz Basel, 1885. Also in O. Knapp.

150. Schonborn, No. 1, 1885. Jahresbericht ueber die Chirurgische Abteilung des Spitals zu Basel, 1885. Also O. Knapp.

151. Schonborn, No. 2, 1885. Idem.

152. Pfeiffer, von Albert, 1886. Zur Behandlung veralteter Luxationen. Inaugural Dissertation, Würzburg, Erlangen.

153. Gurlt, 1886 (?). Pfeiffer, op. cit. No further reference.

154. Blasius, 1886 (?). Pfeiffer, op. cit. No further reference.

155. Maas (from Deus), 1886. Ueber veraltete Luxationen, etc. Inaugural Dissertation, Würzburg.

156, Bruns, No. 1, 1887. Beiträge zur Klinischen chirurgie. Herausgegeben, von R. Bruns, Tübingen, 1889, vol. iv. p. 372. Cf. O. Knapp, Ueber die Operative Behandlung irreponibler traumatischen Luxationen des Schultergelenks.

157. Bruns, No. 2, 1887. Brun's clinic, Tübingen. Also O. Knapp, Beiträge, Bd. iv. pp. 382–384.

158. Garmany, 1888. New York Medical Journal, vol. xlvii. pp. 142–144.

159. Kocher, Th., No. 7, 1889–90. Deutsche Zeitschrift für Chirurgie, vol. xxx. p. 422, Leipzig.

160. Vamossy, 1890. Zur Arthrotomie veralteter Luxationen. Wiener Klinische Wochenschrift, vol. viii., No. 50, p. 969.

161. Wolfler, No. 1, 1891. In Smital (Frank), Wiener Medicinische Wochens., 1890 (40), 2251; 1891 (41), 6, 65.

162. Gould, 1891. Transactions Medical Society, London, 1891–92, vol. xv. p. 457.

163. Cheyne, Watson, 1891. Private communication.

164. Schede, Max, No. 1, 1892. Ueber die blutige reposition veralteter Luxationen, etc. Vide Langenbeck's Archiv für Klinische Chirurgie, Berlin, vol. xliii. p. 365.

165. Schede, Max, No. 2, 1892. Idem.

166. Cotterill, J. M., No. 1, 1893. Edinburgh Hospital Reports, vol. i. p. 486.

167. Cotterill, J. M., No. 2, 1893. Idem.

168. Severeano, C. D., 1893. Nouveau procédé opératoire pour réduire les luxations anciennes de l'humérus. Congrès de Chirurgie. Procès-verbaux, vol. vii. p. 391.

169. Pollosson, No. 1, 1893. Congrès Français de Chirurgie, vol. vii. p. 393. Paris, Traitement des luxations anciennes non rèduit de l'epaule.

170. Pollosson, No. 2, 1893. Idem.

171. Pollosson, No. 3, 1893. Idem.

172. Pollosson, No. 4, 1893. Idem.

173. Pollosson, No. 5, 1893. Idem.

174. Cheyne, Watson, 1893. Private communication.

175. Poncet, 1893. Ricard and Bousquet, Traité de Pathologie Externe, Paris, vol. iv., second edition, p. 737.

176. McCormac, Sir W., 1893. Association Française de Chirurgie, Paris, vol. viii. p. 384.

177. Souchon, Edmond, 1895. Records Charity Hospital of New Orleans, La.

178. Reboul, J., 1895. Bulletins et Mémoires de le Société de Chirurgie, Paris, No. S., vol. xxi. p. 181.

179. Tuttle, J. P., 1897. New York Medical Record, January 9, 1897.

180. Parmenter, John, 1897. Private communication. Buffalo, May, 1897.

181. Ransohoff, Joseph, 1897. Transactions American Surgical Association.

182. Langenbeck, 1858. Charité Annalen, Jahrgang. Also in Lücke, Arch. für Klinische Chirurgie, 1862, vol. iii. p. 306. Also in Spieker, Thesis, Berlin, 1876. Also in O. Knapp.

183. Langenbeck, 1862. Archiv f. Chirurgie, vol. ii. Also in J. Spieker. Der Axillarschnitt zur Resection des Schultergelens bei irreponibler Luxation. B. von Langenbeck, Inaugural Dissertation, Berlin, 1876. Also in O. Knapp.

184. Paget, J., 1868. London Lancet, vol. ii. p. 761.

185. Warren, 1869. Baltimore Medical Bulletin, February 1, 1869, vol. i. p. 38. Also in Medical and Surgical Reporter, Philadelphia, September 25, 1869, p. 257.

186. Reid, Heyge, 1872. Also in O. Knapp.

187. Thiersch-Rosemeyer, 1874. Also in O. Knapp.

188. Langenbeck, 1875. Archiv f. Chirurgie, Bd. xxi. Also in O. Knapp.

189. Annandale, 1875. Medical Times and Gazette, May 29, 1875, vol. i. p. 576. Also Hamilton, 1891, p. 586.

190. Israel, 1876. Beiträge f. Klinische Chirurgie, 1888–89, vol. iv. p. 388.

191. Weinlechner, 1876. Veraltete Luxation im rechten Schultergelenk bei einer 76 Jahrigen, Frau, etc. In Ber. d. k. k. Krankenanstalt. Rudolf Stiftung in Wien (1877), p. 335.

192. Reid-Eichhorn, 1878. Dissertation, Jena, 1887. Also in O. Knapp.

193. Reid, 1880. Idem.

194. Howard Marsh, 1880. In O. Knapp.

195. Hofmokl, 1881. Bericht der K. K. Krankenanstalt. Rudolf Stiftung in Wien f. 1881, p. 409. Also in O. Knapp.

196. Schonborn, 1882. J. v. Perdriot. Étude sur l'arthrotomie dans les luxations anciennes ou irréductibles. Thèsis, Paris, 1892, p. 57. No other reference given.

197. Book, 1883. Jahresbericht von Virchow, in Hiersch, Bd. ii.

198. Pfeiffer, 1886. Ueber die Behandlung veralteter Luxationen. Inaugural Thesis, Erlangen.

199. Bellamy, 1887. London Lancet, 1888, vol. i. p. 1076.

200. Billroth, V. A., 1887. These, ueber veraltete Luxationen. Inaugural Dissertation, Bonn. Also in O. Knapp.

201. Ollier, 1888. Op. cit., vol. ii. p. 69. Also Revue de Chirurgie, p. 904.

202. Shield, 1888. Royal Medical and Chirurgical Society, March, 1888. Also in O. Knapp.

203. Finckh, 1889. In O. Knapp. Beiträge, Bd. iv. p. 382.

204. Fenger, Ch., 1889. Chicago Medical Journal and Examiner, vol. lviii. p. 95.

205. Bardeleben, 1889. In Hinsel (Heinrich). Resectio-humeri bei veralteter Luxation. Inaugural Dissertation, Berlin, 1891, pp. 22–23. The original reference cannot be found.

206. Kocher, Theo., 1889–90. Deutsche Zeitschrift f. Chirurgie, Leipzig, vol. xxx. p. 422. 207–211. Idem.

212. Robson, 1890. London Lancet, July 26, 1890, p. 172.

213. Hinsel, Heinrich, 1890. Resectio-humeri bei veralteter Luxation. Inaugural Dissertation, Berlin, 1891.

214. Phelps, Charles, 1890. Bellevue Hospital Records, Fourth Surgical Division.

215. Wolfler, No. 2, 1891. Wiener Med. Wochenschrift, 1890, vol. xl. p. 2251; 1891, vol. xli. p. 5; 64. Also in Smital (Franz). Zur operativen Behandlung veralteter Schulter Luxation.

216. Thornburn, 1891. Medical Chronicle, Manchester, vol. xiv., No. 2, p. 4.

217. Gwyer, 1891. New York Medical Journal, March 28, 1891, p. 362.

218. Owen, No. 1, 1893. Clinical Journal, London, vol. iii. p. 273.

219. Owen, No. 3, 1893. Idem.

220. McCormac, Sir W., 1893. Association française de chirurgie. Procès-verbaux, Paris, vol. vii. pp. 384–388.

221. Delbet, Pierre, 1893. Archives Générales de Médecine, vol. i. p. 19.

222. Porter, Charles B., 1894. Private communication, May, 1897. Records Massachusetts General Hospital.

223. Wyeth, J. A., 1895. Private communication, October 29, 1895.

224. Monks, G. H., 1895. Private communication, Boston, March 11, 1895. Also Boston Medical Journal, 1896, vol. xxxiv. p. 437.

225. Lejars, F., No. 1, 1895. Leçons de Chirurgie (La Pitié, 1893–94), p. 109. Paris, Masson, 1895.

226. Lejars, No. 2, 1895. Idem.

227. Bickham, Warren S. and Souchon, Edmond, 1895. Records of Charity Hospital, New Orleans, La.

228. Schmittle, Julius F., 1895. Records of Charity Hospital, New Orleans, La.

229. Boone, W. H., 1896. The China Medical Missionary Journal, Shanghai, vol. x. p. 98.

230. Bremken, 1896. La Belgique Médicale, 3d year, No. 46.

231. Chénieux, 1896. Résection de l'épaule droite pour une luxations ancienne intra coracoidienne. Dixième Congrès de Chirurgie, Paris, p. 790.

232. Erdmann, John. New York Medical Record, January 11, 1896, p. 66.

233. Vander Veer, 1897. Private communication, Albany, N. Y., May, 1897.

234. Kocher, Theo., 1889–90. Ueber die Behandlung der veralteten Luxation im Schultergelenk. Deutsche Zeitschrift f. Chirurgie, Leipzig, vol. xxx. p 422.

235. Langenbeck, 1860. Archiv f. Klinische Chirurgie, Bd. xxxi. Also in O. Knapp.

236. Lister, Joseph, 1873. Edinburgh Medical and Surgical Journal, March, 1873., Also British Medical Journal, January 4, 1890.

237. Spieker, G., No. 1, 1876. Der Axillarschnitt zur Resection des Schultergelenks bei irreponibler Luxation nach B. von Langenbeck. Inaugural Dissertation, Berlin.

238. Spieker, No. 2, 1876. Idem.

239. Langenbeck, 1877. Archiv f. klin. Chirurgie, vol. xxi. Supplement Heft ein Bericht verfasst von Dr. R. N. Kronlein, p. 251, Berlin, 1887. This case and the following are the two cases referred to in footnote on p. 76, as being reported by Kronlein in Ollier. Traité des Résections, etc., vol. iii. Membre Supérieur, Paris, 1889.

240. Langenbeck, 1877. Idem. The details of the operation are not found in Langenbeck's work, but are given in the reference by Ollier.

241. Volkmann, 1882. Popke. zur Kosnistik and Therepiedie inveteristen und habituellen Schulterluxationen. Inaugural Dissertation, Halle. Centralblatt f. Chirurgie, Leipzig, 1883, vol. x. p. 28.

242. Nélaton, Charles, 1888. Des causes de l'irréductibilité des luxations anciennes de l'épaule. Archives Générales de Médecine, Paris, 7th Série, 22, p. 434.

243. Schonborn, No. 3, 1885. Jahresbericht ueber die Chirurgie, etc., zu Basel 1885(?). Also in O. Knapp.

244. Mudd, H. H., 1895. Private communication, St. Louis, Mo., December 18, 1895 and March, 1887.

245. Weinhold-Swanz ig, C. Q., 1819. Inaugural Dissertation, Halle. De luxatione ossis humeri.

246. Dieffenbach, 1839. Medical Zeitung, Berlin, December, 1839, No. 51. Also Boston Medical and Surgical Journal, vol. xxxii. p. 382, (from Medical Zeitung). Also Dechambre's Dictionary, p. 726. Also Gazette Médicale de Paris, 1840, 2 S. viii. p. 106.

247. Simon, Gustave, 1852. Viertel-Jahreschrift f. die Praktische Heilkunde. Halla and Hasner, 9th year, 3d volume, Prag.

248. Polaillon, E., 1882. Bulletins et Mémoires de la Société de chirurgie de Paris. Nouvelle Série, vol. iii., p. 129. De la Section sous cutanée des adhésions dans la réduction des luxations anciennes de l'épaule. The case is reported by Mr. Mérigat de Freigny, interne provisoire.

249. Mollière, D., 1886. Congrès Français de Chirurgie, Procès-verbaux, vol. ii. p. 300. Paris, 1887.

250. Mears, J. Ewing, 1876. Philadelphia Medical and Surgical Reporter. 1877, vol. xxxvii, p. 237.

251. Langenbeck, 1877. Kronlein, Archiv f. Chirurgie.

252. Patterson, 1879. Glasgow Medical Journal, 1878, vol. x. No. 12, p. 530. Also Centralblatt f. chirurgie, 1879, p. 328.

253. Thomas, de Tours, 1885. Revue de Chirurgie, vol. v. p. 715. Also Ollier, op. cit., vol. ii. p. 77.

254. Desprès Armand, 1879. Bulletin de la Société de Chirurgie, Paris, Janvier 15, 1879.

255. Reid, Heyge, 1877. Also O. Knapp.

256. Adams, 1888. Royal Medical and Surgical Society, March, 1888.

257. Brinton, J. H., 1896. Private communication. This case is to be published in Dunglison's College and Clinical Record for November, 1897; now in press. Philadelphia.

258. Küster, E., 1882. Ein chirurgisches Triennium, 1876–78. Berlin and Hassel, 1882, p. 256.

259. Schede, 1892. Langenbeck, Archiv f. klinische Chirurgie, Berlin, vol. xliii. p. 365.

260. Brawn, Tilden, 1897. New York Medical Record, April 17, 1892.

261. Post, Alfred C., 1861. American Medical Times, New York, vol. ii. p. 100.

262. Phelps, A. M., 1897. Medical Record, April 17, 1897. Also of September 21, 1897.

263. Phelps, A. M., 1897. New York Medical Record, April 17, 1897.

264. Ricard, No. 1, 1892. Gazette des Hôpitaux, Civils et Militaires, Paris, vol. lxv. p. 1176.

265. Ricard, No. 2, 1892. Idem.

266. Samosch, J., 1889. Beiträge zur operativen Behandlung der habituellen Schultergelenksluxation, in G. Bruns, Beiträge zur klinische Chirurgie, Bd. xvii. 3, p. 803.

267. Gerster, Arpad, 1884. New York Medical Journal, p. 390. Also Rules of Aseptic and Antiseptic Surgery, p. 8, note 2.

268. Burrell, H. L., 1897. Transactions American Surgical Association. American Journal of the Medical Sciences, August, 1897.

269. Burrell, 1896. Idem.

270. Burrell. Idem.

271. Albert, E., 1888. Internationale klinische bei einer habituellen Luxation des Schultergelenks.

272. Cramer, F., 1882. Resection des Obearmkopfes wegen habitueller Luxation. Berliner klinische Wochenschrift, vol. xix. p. 2.

273. Popke, 1882. Op. cit.

274. Sacré, 1883. Observations chirurgicales recueillies dans le service de M. Sacré, iv. Luxation incomplète de l'humérus Résection de la tête humérale. Guérison. Observations recueillie par M. le Dr. Bock, Journal de Médecine, de Chirurgie et Pharmacie, Bruxelles, vol. lxxvii. p. 236.

275. Owens, No. 2, 1893. Clinical Journal, London, vol. iii. p. 273.

276. Monks, G. H., 1896. Boston Medical and Surgical Journal, April 30, 1896.

DISCUSSION.

DR. J. EWING MEARS, of Philadelphia.

Several years ago, when the chair was occupied by the founder of this Association, a very elaborate paper was presented by our worthy Fellow, Dr. Conner. It was very full and complete, so much so that the Chair remarked that it was not necessary to discuss it, and moved to the next order of business. I think we might well apply this remark to the very interesting paper just presented on a most important subject by Dr. Souchon. If it were possible to discuss it or to suggest any criticism, I should like to say that I think, for the purpose of instruction and for practical purposes, the term "irreducible" should be changed to "unreduced" dislocations. I conceive that to-day no dislocation is not reducible; never mind whether it is recent or chronic. Irreducible is a term which we can apply when the efforts at reduction are limited to manipulation, but when operative interference can be so readily applied it seems that the term should be eliminated. A very important point for us to determine is when a dislocation becomes old. At what period after the occurrence of a dislocation shall it be deemed inadvisable to institute manipulative efforts. I think it is a rule in England to fix a period at which a manipulative effort should not be made in cases of dislocation of the shoulder-joint to the time when union should occur after fracture. Six or eight weeks, for instance, after a dislocation has occurred at the shoulder-joint should be sufficient, and after this the law or the rule should be made that no efforts at reduction should be attempted. Then the dislocation is said to be chronic or old, and manipulative procedures for its relief should be abated. It seems to me that this is very simple, and could be well accepted—*i. e.*, the fixing of the time when union should take place after fracture. With regard to the operative treatment of recent dislocations, we are certainly indebted to Dr. Souchon for having brought this subject up to date by his careful investigation of all the recorded cases. It occurs to me that we could simplify very much the methods of interference in recent cases. In all cases of recent dislocations which cannot be reduced by manipulation, and when it is thought proper to interfere by operation, I think that either an incision through the deltoid, or, as suggested and practised, the elevation of the deltoid muscle should be made, as by this means the joint can be thoroughly ex-

posed and the head of the bone replaced. In this way we would avoid the employment of the various incisions which have been made as recorded by Dr. Souchon, either those anteriorly or those in the axillary space, or posteriorly.

Now, what are the indications for operative interference in old dislocations? Disability and pain. With regard to disability, it has been my experience that when the operative procedures such as are usually employed, as for example, the excision of the head of the bone, the use of the upper extremity and the restoration of function have not been such as we would desire. I have seen in some cases of old unreduced dislocations as much freedom of movement as has been accomplished by excising the head of the bone in other instances. In performing excision of the head of the bone the section is made through the surgical neck of the bone, for we cannot accomplish much by removing the portion above the anatomical neck. In taking away that portion above the surgical neck we take away a very important part of the bone, and we limit very much the important movement of rotation. We preserve extension, etc., but seriously impair rotation. In those cases of old dislocation, in which the disability is not marked, time will improve the condition, and the use of massage and such other measures as are familiar to us will largely remove the existing disability. This being the case, can we hope to give the patient anything better by excision? In those cases where the disability is very great, and especially if it be in a workingman, then the question should be considered as to what measures had best be taken.

With regard to the relief of pain, what can be done? Undoubtedly it is the duty of the surgeon in these cases to interfere. Any operation which will remove the pressure—whether it is excision or the operation I performed in 1876, when I made a subcutaneous section of the neck of the bone—is justifiable and should be performed. With regard to the operation to which I have referred, I thought it would be one of very much less gravity than that of excision The operation was founded upon the experience which we had with regard to subcutaneous section of the neck of the femur, and was not a difficult one. The patient recovered largely all the movements of the upper extremity, and was relieved from pain which had existed for over a year. The case was one of unrecognized subcoracoid dislocation. With regard to the different forms of dislocation, which became chronic, I believe it is the opinion of surgeons that the subcoracoid

is the most frequent, and the one most generally not recognized, especially outside of the large surgical centres.

To return to the case on which I operated in 1876: my object was to form a false joint, so that the movement of the head of the bone would not cause pain. At the end of one year the patient died, and I was fortunate enough to secure the upper portion of the humerus. I found that a false joint had not been formed and that union had taken place. The arm was carried in the Velpeau position; but, notwithstanding the efforts made, union occurred at an obtuse angle in such a manner as to remove the head of the humerus from the brachial plexus. It was found that the pathological tissues had been stretched to such an extent as to permit the head of the bone to almost return to the cavity of the glenoid. The operation accomplished what was needed—that is, relief of pain. Distribution of the anterior and posterior circumflex arteries is to be considered in performing this operation.

Dr. Joseph Ransohoff, of Cincinnati.

Uncomplicated dislocations of the shoulder of recent occurrence are so readily reduced under anæsthesia by manipulation that operative treatment can very rarely come into question. It is only when the dislocation is accompanied by fracture of the humeral shaft, or below the anatomical neck, as by the separation of one of the tuberosities, or a dislocation of the long head of the biceps with its twining about the humeral neck, that primary reduction may be accompanied by insurmountable difficulties. Under these circumstances there can hardly be a question about the propriety of immediate operation. The very brilliant results obtained by McBurney and others by the use of a bone hook inserted into the upper fragment through an open incision, thereby making reduction of the dislocated head feasible, will in the future justify like procedures in all similar cases.

In unreduced dislocations of older date, the question of operative interference must be entirely determined by the degree of disability entailed. Where this is slight, and the patient is enabled to gain a livelihood, and pressure-symptoms produced by the dislocated head are absent, the advisability of operative interference must be questioned, particularly if the dislocation is one of more than two or three months' standing. Positive indications for operative interference are pressure upon the vascular or nerve trunks with which the head of the humerus has formed new relations.

Quite recently, Reerink has tabulated forty-eight cases of unreduced dislocations of the shouder, twenty-four of which were of the subcoracoid variety. In point of time the luxations had existed from eight days to two years. In fifteen of these cases dislocation was associated with separation of the greater tuberosity of the humerus, once with fracture of the anatomical neck and once with the surgical neck of the humerus. In one instance there was a fracture of the lesser tuberosity, and in another of the anatomical neck. In still another case there was a fracture through the anterior margin of glenoid fossa.

The operations suggested and practised for irreducible dislocations of the shoulder are, 1, Subcutaneous division of the adhesions. 2, Subcutaneous osteotomy of the neck of the humerus. 3, Arthrotomy. 4, Resection.

Only the French surgeons advocate to-day the subcutaneous division of adhesions, in the hope of so freeing the humeral head as to facilitate reduction. Subcutaneous osteotomy of the neck has been performed twice by Desprès and Mears, with satisfactory results.

The operations that certainly are the most frequently indicated are, arthrotomy and resection, between which a choice must be made according to the conditions found. The end results obtained are largely proportionate to the time of interference, and it may be laid down as an axiom, that the earlier an operation is done the greater the probability that relief will be afforded by arthrotomy. In old-standing cases, where arthrotomy is even successful, the humeral head and neck must often be uncovered before reduction is feasible, that its nutrition is endangered, and in a very large proportion of cases secondary resection for necrosis has had to be made.

Furthermore, in old-standing cases, even where reduction is accomplished, there remains where the head had been contained a large cavity bounded by firm fibrous walls and often lined with an imperfect serosa, which closes with difficulty, and, like all surgically dead spaces, affords a ready nidus for infection. It is probable that if immediate union were not sought for when this condition is encountered, and resort were had to packing, that fewer grave wound infections would result from operations for inveterate dislocations of the shoulder. The immediate fatality following the operation is very considerable, since, according to Reerink, in forty-seven operations at least fourteen resulted in grave infection. Probably even a larger number failed of perfect primary union. Eight of the cases terminated fatally from

hemorrhage or local or general sepsis, although in one of these death was ascribed to miliary tuberculosis.

In regard to the end result obtained, the data I have found in the literature are very unsatisfactory. It seems to be clear, however, that the earlier interference is practised, that is, before irreparable changes in the glenoid fossa have taken place, the better are the end results. Resection will not be necessary, and when primary union follows, the end result is quite as good as in recent dislocations reduced by manipulation alone. In a case of Parmenter's, done on the eighth day, all movements of the arm were restored except those depending on the deltoid.

In old-standing cases it has been shown that the muscular atrophy, which had existed before the operation, was recovered from either very slowly or not at all.

The present status of the question of operative interference in shoulder luxations may be summarized as follows:

1. Immediate operative interference is indicated when the ordinary methods by manipulation under anæsthesia have failed.

2. In irreducible dislocations, operations should not be delayed until irremediable changes have taken place in the capsule and about the humeral head. In comparatively recent cases arthrotomy offers the best end results.

3. In old-standing cases the conditions found must determine the choice between arthrotomy and resection.

4. In unrecognized dislocations of long standing, one year or over, only grave compression symptoms must be recognized as indications for interference.

5. Special attention must be given to the prevention of sepsis, since in a very large proportion of cases recorded, sepsis has been either the cause of death, or, by the destruction of the humeral head or obliteration of the joint cavity, has frustrated the very object of the operation.

I beg to append the history of one case operated on by me at the Cincinnati Hospital.

W. E., farmer, aged twenty-one years, admitted to the Cincinnati Hospital February 2, 1895.

Present history: Three and one-half months ago patient was thrown from a horse and landed on the shoulders and elbow, after which he was unable to use his arm. General condition good. Muscles of the left scapula, arm, and forearm are considerably atrophied, the head of

the humerus is dislocated forward, leaving a prominence below the outer part of the clavicle. Abduction of elbow from side to body impossible beyond an angle of about 30°. Patient unable to get his hand to the back of his head except by raising the shoulder. Head of the humerus is very firmly fixed in the new position.

February 4th. Under A. C. E. anæsthesia an attempt was made to reduce the dislocation, but it failed. An incision was then made about six inches in length from over the coracoid process downward and outward in the line of the humerus and between the fibres of the deltoid. The head of the humerus in its new position was readily exposed, and, by means of elevator and cutting with the scissors, the adhesions surrounding it were broken up or divided. This part of the operation proved to be a very difficult task. The head of the humerus maintained its normal shape, and was largely covered with unchanged cartilage. In the lower part of the capsule there was a large rent, across which bands of adhesions had formed. In the next step the glenoid fossa was exposed. Along the edges it was filled with exuberant granulations, which were removed with a sharp spoon, and which were tough and bled freely. The central part of the cavity was covered with normal cartilage. An effort to bring the head into the glenoid fossa failed, until the capsule was divided in its entire circumference, and the humeral neck exposed down to the lower borders of the tuberosity. When the reduction was once accomplished it was easily maintained. Silkworm-gut drainage was used. The arm was placed by the body, with the hand over the opposite shoulder, and held in position by bandage.

During the first forty-eight hours there was some elevation of temperature, but this subsided without suppuration. A stitch-hole abscess formed later, but did not interfere with the end result. The patient was discharged on May 26th, with the wound healed. The function of the arm was very much improved as compared with what it was before the operation. Rotation was fairly practical, but the arm could not be elevated from the side of the body at more than an angle of about 45°. The atrophy of the muscles of the arm and part of the deltoid had not been improved. Except for the latter, the roundness of the shoulder had been completely restored.

April 18, 1897, letter was received from the patient from Charlotte, Carter County, Ky., in which he states: "I consider that my arm has been greatly benefited. The numbness is entirely gone, and my

fingers are no longer stiff. I can move the arm forward, backward, and inward, but outward motion is limited. Since you operated upon my arm I have been enabled to do a great deal of work, and feel that my arm is getting stronger all the time."

DR. J. E. OWENS, of Chicago.

My experience with this class of cases is limited to three. The first occurred about six years before the death of Professor Gunn, and was a recent dislocation which the doctor failed to reduce. It was of the subcoracoid variety. At the time, after unsuccessfully making strenuous efforts at reduction, an incision was made through the deltoid into the joint, and reduction effected. Suppuration, caries, and necrosis set in, and after drainage and curettement resection was necessary. I am unable to state the ultimate result, but I know the patient did not die. Six years ago I had occasion to see, near Chicago, a supposed case of fracture which was really a dislocation of about seven or eight weeks' standing. My efforts at the time to reduce it failed. Within a week the patient was brought to the hospital, where I again made an unsuccessful attempt at reduction. An incision was then made through the deltoid muscle, and we opened the capsule. Still I was unable to reduce the dislocation. The subscapsular tendon was next cut, with no better results. I could find no band that was holding the bone, and finally did a resection. The man was very fond of horses, and wrote me afterward that the result was very satisfactory, and that he was able to drive almost as well as before. The third case was one of subcoracoid dislocation which had been overlooked. At the end of eight weeks I had the patient brought to the hospital, but I failed to effect reduction. It was my intention, in case of failure to reduce, to perform excision. In performing Kocher's method during the external rotation of the arm the upper end of the bone suddenly gave way. The position was at once very much improved, the pain diminished, and finally disappeared. Persistent and active motion were employed in order to make a false joint. I kept in touch with the case for seven months, and at the end of that time there was an absence of pain; the range of movement was greater, and usefulness increasing. I was very well satisfied with this partly accidental result. There had been a neuritis, and the patient, a lady, had had very uncomfortable symptoms in the cervical spine and neck.

Dr. John B. Roberts, of Philadelphia.

I wish to refer to one case, that of a woman with an unrecognizable dislocation, who came to me about a year after the injury. I made various efforts at reduction, and used much force, the result being that considerable bruising of the soft parts was done, and I had to postpone operative interference until the inflammatory process disappeared. Later I found that I had put the head of the bone on the brachial plexus, and the woman was worse off than ever. She suffered intense pain, followed by trophic changes in the fingers, and I had to do a resection. I found great difficulty in getting the head out of its deep position, and much hemorrhage resulted. The woman succumbed from the shock or hemorrhage within twenty hours. This case convinced me that hereafter I should probably do arthrotomy, without making much attempt at reduction in old cases of dislocation.

Dr. L. McLane Tiffany, of Baltimore.

It is proper to make a very wide difference between cases occurring in recent years and those of years ago; but I see no reason at all why the shoulder joint is to be considered in any way different from any other joint. We open other joints, and why should we not open the shoulder-joint? The injuries of the elbow, especially those which are so common in childhood, can be opened without difficulty, and a good joint results, and it seems to me that the same measure should be applied to the so-called irreducible dislocation of the shoulder. A free opening should be made and a bone replaced in its proper position. If the tuberosity is torn off it should be held in place with a suture, and good results may be expected. As to the time when the operation should be done, no hard-and-fast rule can be laid down. It is the ability or inability of the surgeon to see and to do that is necessary. The shoulder may be irreducible in a very short time, or it may be reducible after several months. A free opening should be the rule. Until the bone is firmly fixed in its wrong position I do not think a resection should be done. A resection will sometimes relieve pain and give a most useful arm; for though the bone does not go back to its proper position, the result will be a painless and very useful arm. It is the power to carry the elbow from the side which is the motion not regained after excision of the upper end of the humerus.

Dr. Souchon. In the second part of my paper I consider all the forms and varieties of irreducible dislocations, and the first and fore-

most are those which should not be operated, whether because the limb is of good use to the patient in its abnormal condition, or because the subject is debilitated or too old, or because the muscles are fatty and sclerotic, etc.

The force to be used in attempting to reduce before operating is of paramount importance, lest it cause lacerations, forcing an operation through bruised tissues, and its consequences. Disastrous results have followed even at the hands of the famous Kocher. Dr. Roberts' case is another instance. In cases of recent irreducible dislocation it is most important to operate before union of the bones has taken place. The reading of the difficulties, dangers, and perplexities experienced by the most skilful in operating after the union of the bones will suffice to convince one of this fact. An important point is the care of the deltoid muscle and its nerve, the only muscle, we may say, that abducts the arm, animated by a single nerve, the circumflex. Langenbeck's acromio-humeral incision, often paralyzing all the fibres in front of it, from the section of the nerve fibres, is now universally condemned. The coraco-humeral, or anterior incision close to the anterior border of the deltoid, is the incision, for obvious reasons. Convex incisions are to be abandoned, of course. The after-treatment of these cases is of vital importance; many fine operations have been spoiled for lack of proper attention to this point; no detail is to be neglected. All the features are thoroughly studied in the third part of this paper.

THE SURGICAL TREATMENT OF CONGENITAL ANO-RECTAL IMPERFORATION CONSIDERED IN THE LIGHT OF MODERN OPERATIVE PROCEDURES (STROMEYER'S SUGGESTION; KRASKE'S OPERATION AND ITS MODIFICATIONS; THE COMBINED PERINEO-SACRO-ABDOMINAL OPERATIONS, ETC.);

WITH TWO TABLES SHOWING THE RESULTS OF COCCYGECTOMY AND THE SACRAL OPERATION FOR IMPERFORATION. ALSO THE REPORT OF A PERSONAL EXPERIENCE WITH KRASKE'S OPERATION IN THIS CONDITION.

BY RUDOLPH MATAS, M.D.,
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I.

THE surgical treatment of the congenital deformities of the ano-rectal region embraces a great number of procedures. The surgeons who have proposed them had always in view, 1st, to give immediate relief to the intestinal tension by removing the obstruction, and thus establish the fecal circulation; and 2d, to establish an anal outlet that would as nearly as possible imitate the functions of the natural orifice.

Success in accomplishing this purpose must be measured by the fulfilment of certain conditions. The new anus must give easy and painless exit to the feces, whatever their consistence may be. It must be controllable—*i. e.*, able to close hermetically and voluntarily in the intervals between the acts of defecation. It must be placed in the most favorable situation, considering

that for this purpose there can be no better site than that which was originally selected by Nature herself. Finally, all these conditions must be permanent and not liable to retrogressive changes in the lapse of time.

The congenital malformations which call for the restoration or the creation of the anal outlet may be grouped into two great classes if we view them purely from the clinical and operative point of view. The first comprises all the congenital malformations of the *anus*, including in this category, abnormal narrowing or stenosis, occlusion by membranes of varying degrees of density, partial or complete absence of the anus and other abnormalities of configuration. The second includes the malformations of the *rectum*, including in this its termination: (1) in a blind cul-de-sac at a variable distance from the perineum; (2) its termination in fistulous or other openings into neighboring pelvic organs or channels, such as the bladder, the vagina, the urethra, the normal anus being present or absent; (3) by more or less imperfect and always anomalous terminations in the skin of the genital and perineal region, the normal anus being absent or imperfectly developed; (4) by a cloaca in common with the vagina; (5) finally, the total absence of the rectum. This classification is doubtless more clinical than in conformity with embryological ideas, but as we are not at present interested in the pathogeny of these conditions, and solely in the discussion of their surgical treatment, the present grouping will be more than sufficient for our purpose.

I shall furthermore circumscribe my remarks on the present occasion to the surgical or operative treatment of the, strictly speaking, *obstructive or atresic* malformations of the ano-rectal outlet, in which there is no avenue whatever (not even a fistulous communication with another viscus) for the escape of the intestinal contents, and in which prompt action is required to save the life of the newborn infant.

II.

I shall not tarry long in the discussion of the treatment of the deformities of the anal orifice or of the rectum, which are charac-

terized by an abnormal contraction (stenosis), or by the formation of membranous diaphragms of varying thickness and degrees of contraction. The gravity of this condition, as well as the severity of the treatment, must depend upon the degree of impediment to the accomplishment of the anal function as well as upon the situation of the obstruction. When the stenosis is of moderate calibre and the stricture is soft and yielding, dilatation or divulsion, followed by the systematic introduction of bougies, will probably effect a cure. But when the obstruction is formed by a hard, fibrous, and rigid diaphragm of considerable thickness and of small calibre, simple dilatation will prove ineffectual. Dilatation may do well as a palliative measure, but rarely as a radical cure. Here centuries of experience with dilatation, divulsion, cauterization, and incision (proctotomy and rectotomy) have resulted in the final recognition of their inutility, simply because any procedure that will leave a cicatricial ring must result in recontraction, and with it a return to the primitive stenotic condition with all its evils.

The simplicity and benignity of the old methods of treatment are more apparent than real. A mere glance at the long list of recorded cases demonstrates that not only do the so-called simple methods almost invariably result in failure, but they are also a fruitful source of endless miseries, and serious if not fatal complications. In addition, the duration of the treatment by dilatation is not the least of its objections. The little patients are condemned for years, if not all their lives, to the tyranny of a painful and constant treatment. The strictures relapse more promptly and are more rebellious to treatment than the acquired strictures of the urethra in the adult, and in consequence require the almost daily introduction of some form or other of dilating agent. The constant friction caused by these repeated manipulations and interference with the natural functions, by the disease itself, soon lead to proctitis, rectitis, ulceration, fissures, with their accompanying tenesmus; and, if the strictures are high up, perirectal abscess and sometimes peritonitis. The benefits of the treatment by incision are even more doubtful than those obtained by dilatation. Whenever the stricture is a little high in the rectum

its division with the knife (rectotomy) is not only uncertain and unreliable as a curative agent, but is dangerous. The danger is chiefly from infection of the perirectal tissue, though risk from hemorrhage in the infant is not to be disregarded. Finally, simple incision will never accomplish any lasting good without dilatation, as the contractility of the stricture will reassert itself. It is only when the obstructing membrane is thin and formed by a simple duplication of the mucous membrane that any permanent good can be accomplished. The most rational, as well as the most successful treatment for the diaphragmatic form of stricture is the resection of the obstructing membranous diaphragm, with a restoration of the continuity of the mucous lining of the bowel by suture. The comparatively low position of these strictures, usually from one to two inches from the anus at furthest, favors this mode of intervention. When the strictures are more anal than rectal, the best plan is to treat the condition as if it were one of complete imperforation—*i. e.*, by resecting the whole strictured area and bringing the mucosa down to the margin of the anus, where it is sutured to the skin. The benefits of this mode of treatment have been well established by the results obtained in recent years by Villar,[1] Péan,[2] Jaboulay,[3] Lannelongue,[4] Duplay,[5] Broca,[6] Bouilly[7] (1882), Berger,[8] (1888), Terrier[9]* (1891), Mauclaire,[10] and others.

* This case was reported by Prof. Terrier to the Société de Chirurgie of Paris, February 24, 1891 (Rev. de Chirurgie, p. 349, Tom. xi., 1891), and is particularly instructive. M. Terrier expressed himself as a partisan of extirpation, not only in the treatment of congenital but also of syphilitic strictures of the rectum, and related the following case: Male, at the age of 21 began to suffer very seriously from the effects of a neglected *congenital* stricture of the rectum. In 1872, Czerny operated for secondary fistula in ano. In 1885 McKenzie, of Melbourne, cut the stricture posteriorly (linear rectotomy) without relief. In 1880, Thiersch, of Leipzig, again repeated the rectotomy, with no better results. In 1882, Bergmann, of Berlin, again resorted to rectotomy without benefiting the patient. In 1889 the patient consulted Terrier. The finger introduced into the anus reached the stricture at a depth of 4 centimetres. It was recognized as an obstructing diaphragm with a central orifice; the end of the finger could barely be insinuated into the opening. The rectum, apart from this stricture, was apparently healthy, with the exception of the posterior cicatrices caused by the previous operations. On June 2, 1889, M. Terrier extirpated the inferior extremity of the rectum by perineal incision, and succeeded in preserving the anal sphincter. The mucosa was then sutured to the anus. The patient was discharged well, July 20th. There was still some incontinence when the stools were liquid, which indicated that the functional value of the sphincter had not been completely restored.

III.

Total Imperforation of the Ano-rectal Tract.

Under this heading we shall group all those cases in which the anus and rectum have failed to meet through defective development of either the proctodenum or enteron, and in which the terminal pouch of the colon or rectum is at a greater or less distance from the perineum. The anus may be well formed, or rudimentary, or it may be totally absent; but, in either case, it does not communicate with the upper intestinal tract. The variations in the relative distance of the rectal pouch from the perineum may measure from a few millimetres to five or more centimetres, or the enteron may be entirely absent and remain out of the pelvis altogether.*

It is immaterial for our present purpose what these particular variations are. Suffice it to say that we must deal with the group generically, as the differentiation of the species is most frequently impossible at the bedside. The surgeon has but one course open before him, and that is to presume that *there* is a rectal pouch in the pelvis, and that it is his duty to find it and place it as near the natural outlet as possible or in the region which will most nearly approach the situation of the anal orifice.

IV.

Evolution of the Modern Operation of Proctoplasty.

The history of the operative treatment of congenital occlusion of the rectum is one of the most interesting chapters in

* An important fact to remember in this connection is that in the vast majority of the recorded cases of ano-rectal deformity the rectal end of the colon or enteron exists and occupies some portion of the pelvis. The cases in which the rectum is totally absent or is totally inaccessible through a perineo-sacral opening are relatively few. Bodenhammer, whose erudite and laborious researches have made him *facile princeps* among the systematic writers on the subject, collected a total of 465 cases which he had gathered from all sources up to 1879. Out of this total only species VIII and IX. of his classification, in which the rectum and colon are totally absent, furnished the comparatively small contingent of 41 observations. (Vide N. Y. Med. Journ., May 25, 1889, vol. xlix.)

the evolution of surgical methods, and faithfully reflects the progress of our art.

From the remotest antiquity the congenital closure of the anus or rectum was noticed by the Greek, the Roman, and the Arabic physicians. They, however, looked upon it generally as beyond the power of art to remedy, and, consequently, as possessing no interest in their estimation beyond that of a *lusus naturæ*.

With greater diffusion of knowledge and observation, the relief of these conditions by opening up the natural outlet, when this existed, by punctures or incisions, naturally suggested itself. This must have been especially true of those cases in which the anus already existed, and when a rudimentary depression indicated its natural situation, and where the bulging or tension of the rectal pouch at the anus appealed to the knife for relief.

We thus find that as far back as the seventh century Paulus Egineta[11] once relieved an imperforate anus by plunging a knife into it. His method, which was subsequently generally adopted and practised even until comparatively modern times, was followed by dilatation with wax bougies or other means. In 1834, Breschat[12] reported that he had obtained a dozen successes by this method. In 1844, Berard[13] had extended the method of perineal incision and dilatation to a case of congenital *atresia ani*, with vulvar fistula, and Vidal de Cassis,[14] Guillon,[15] Danyan,[16], Malgaigne,[17] Velpeau,[18], popularized it with their great authority in France. In England, Benjamin Bell,[19] in 1787, advocated perineal incision in the median line, followed by dilatation of the wound by the finger, and if the rectal ampulla was not found he sought for it in the hollow of the sacrum with a trocar.

This operation was successfully performed for the first time in the United States in 1800 by Dr. John P. Campbell,[20] of Flemingburg, Ky. Copeland Hutchinson,[21] in 1822, slightly modified Bell's operation without any advantages by cutting with the knife no further than one and a half to two inches, and, after this limit, trusted to the trocar only. Dieffenbach[22] (1845)

made a small crucial incision over the site of the rudimentary or absent anus, excised the triangular flaps that resulted from this incision to enlarge the space, and continued to incise in the median line for one inch. Then the trocar was substituted for the knife, and this was made to penetrate upward and backward in the direction of the hollow of the sacrum until the rectal pouch was tapped, when the path of the trocar was dilated and the meconium allowed to escape. If this procedure failed, the canula was allowed to remain *in situ*, and a piece of sponge was forced through it to dilate the space beyond. If, after this dilatation, the pouch could not be reached, colotomy was performed. Roux[23] de Brignolles (1835) differed from his contemporaries in paying special attention to the preservation of the sphincter fibres while dissecting the perineum. He used the knife throughout, the scalpel first, and the straight bistoury to perforate the pouch. He believed that the sphincter fibres preserved their functional value in these rudimentary conditions.

I have referred to these methods simply to illustrate the practice that prevailed up to the first half of the present century. It is evident to any student of surgery of the period that there was no great progress accomplished up to a relatively recent epoch, save in the more general adoption of operative interference for the relief of these congenital deformities. Then the sole aim of the operator was to reach the ampulla, and it was a great triumph if he succeeded in tapping and draining it by a happy puncture or a plunge of the bistoury made in the dark: after this was done a long, tedious, and usually unsuccessful process of dilatation followed, which had to be kept up for years under penalty of recontraction. The famous Dionis*[24] (1740) and his

* From Dionis (1740) to Velpeau (1847) we see in all the writings on this subject that the tendency of the artificial opening was to recontraction. Bodenhammer, to whose great erudition I am indebted for these data, quotes the case of "Mr. Miller, of Methven, England, in which the tendency to recontraction was so great that he was compelled to repeat the operation ten times before the little patient was eight months old." Cases are related by McEvoy, Smith, Ritter, Broca, and other later writers, which are similarly rebellious and unfortunate. I have mentioned Terrier's case as a typical illustration of the failure of incisions in ordinary congenital stricture.

followers, nearly a century after him, among whom was Mr. Malyn[25] (1841), an English writer, maintained that the retraction of the perineal muscles, after division, efficiently prevented recontraction, and that this recontraction was the result of insufficient incision. But the records of the period are the best contradiction to this assertion.

The objection to the method of simple punctures and incision in complete obstruction is that it exposes the tissues to septic infection from secondary contraction and closure of the anal opening. In the more aggravated cases, in which the rectal pouch is punctured and evacuated at a considerable distance from the perineum, the danger from peritoneal and perirectal infection are infinitely increased. That these evils were fully appreciated in 1835 is indicated by the profound impression produced by the *Memoires* of Amussat,[26] in which he announced his new and improved method of proctoplasty, and by the rapid and general acceptance of his suggestions.

The new operation proposed by Amussat, and practised by him in 1835,* marks a great step in advance of his predecessors, and is to be regarded as one of the most conspicuous landmarks in the history of this branch of surgery. Amussat proposed that not only should the rectal pouch be sought for by a free and systematic dissection of the perineum, but (and this was his great merit) that after it had been found it should be freely detached from its surroundings, so that it might be dragged to the level of the skin, where, after opening and evacuating it, the mucous membrane could be sutured without tension to the skin, where it would unite by primary intention.

Thus would a continuous mucous lining be formed for the anal passage, which would prevent fecal contamination of the wound and permanently protect the parts from future cica-

It was doubtless these bad effects, and the great liability of these infants to relapse that caused Bigelow and the elder Gross to hold very gloomy views on this subject, and led them virtually to repudiate all operative intervention for imperforate anus. It is perhaps owing to their influence that so many of the practitioners of the past generation in this country took a similar position when called to relieve these cases.

* The principle underlying this operation was suggested by Dieffenbach in his operation of cheiloplasty, 1828.

tricial contraction. The manifest advantages of Amussat's operation over the old methods rapidly gained for it general acceptance, so that it soon became the classical operation—a position which it holds to the present day in all cases in which a rectal pouch is accessible by the perineal route. Amussat's first operation not only opened the door to future progress in this line of surgery, but led to the suggestion of another operative principle, which was destined to play a great part in the surgery of the pelvis long after the origin of the suggestion had been forgotten even by many of his own countrymen.

We refer to Amussat's recommendation to enlarge the field of operation by the excision of the coccyx or a part of it, with the view of accomplishing his great object—*i. e.*, the suture of the rectal mucosa to the skin. This recommendation was evidently suggested by the objections that were raised at the time against the general application of his method by his contemporaries, who argued, with some reason, that in those cases in which the rectum was very incompletely developed and remained high in the pelvis, it would be impossible to drag it down to the level of the perineal opening, and thus render its suture to the skin impracticable. To this Amussat replied that the incision should be carried upward to meet the pouch, so that if the ampulla could not be detached sufficiently to bring it to its normal position, the incision should be extended to the coccygeal region to meet it. He therefore advised that the perineal incision be made long enough to reach the coccyx, or to extend it beyond and to the left border of this bone; or, if more room was needed, to remove the coccyx, as he had done, in part, on one occasion, in a desperate case. This case I have recorded as No. 1 of my table of coccygectomies for imperforation, and marks the first step in the direction of what is now known as Kraske's operation.

Returning to Amussat's operation, we must note that Goyrand[27] became one of its chief promoters. His numerous and careful studies of the anatomical and pathological peculiarities presented by the parts involved in the operation, such as the exact relation of the peritoneum to the ampulla and pelvic

floor, and the disposition of the fibres of the perineal muscles, led him to lay down the rules governing the operation with great precision.

Accepting Amussat's original operation without reference to his subsequent recommendation of coccygectomy, as the first and still most satisfactory method of obtaining a plastic restoration of the anal outlet (proctoplasty), we shall review its various steps with some detail, in order to facilitate the discussion of the more recent modifications and additions that have been suggested by modern experience.

Presuming that we are about to deal with a case in which there is a total anal occlusion, and there is no evidence of communication with the rectum, and that the latter does not apparently discharge its contents into the vagina, bladder, or urethra or other channels, we must begin by: (1) a simple median perineal incision, to be followed by (2) search for, and isolation of, the rectal pouch, (3) dragging of the pouch to the level of the skin in the perineal wound, followed by (5) the puncture and evacuation of the rectum, and (6) suture of its mucosa to the skin. Such would be the steps of a typical Amussat operation.

V.

Before considering the technique of the operative treatment it will be well to refer to some measures recommended to clear the diagnosis as to the anatomical conditions before deciding upon the operation. The presence of meconium in the urine, or its appearance in the vulva or vagina, is clearly suggestive of a fistulous intestinal communication. The presence of meconium in the urine calls for prompt action, especially if the escape of intestinal contents into the bladder is very free and continuous. While there are numerous cases on record in which congenital entero-vesical or rectal fistula have been comparatively well tolerated (in some instances for years), it is the rule to find the bladder extremely sensitive to the presence of fecal material; and it is not long before septic cystitis and other more serious consequences of fecal intoxication make their appearance and

incapacitate the patient for surgical treatment. Infants passing meconium with the urine must, therefore, be treated just as promptly and radically as if they had been born completely imperforate.

When the intestinal fistula opens into the vulva, vagina, or uterus, or any part of the cutaneous surface, then the urgency of intervention depends upon the extent and position of the intestinal communication. If the discharge of feces and gases is freely effected through the vagina, there is no urgent demand for action, as the intestinal tension is relieved and the patient's life is not in danger. Time is given for the choice of the procedure and of favorable opportunity in such cases. When, however the fistulous communication is very small, and does not allow a free escape of meconium, and, especially if the opening is seated high up in the vagina or other part of the genital tract, then operative treatment is immediately indicated, and must be conducted on the general methods applied for total imperforation, viz.: restoration of the normal anal outlet *plus* separation and closure of the fistulous connections. As to the diagnosis of the position of the rectal end or enteron, and the possibility of recognizing its descent into the pelvis, its relations to the pelvic floor or total absence from pelvic cavity, it is practically impossible to determine this before operation. To introduce an exploring or aspirating needle in the direction of the hollow of the sacrum through the perineum or the anal vestige, if this exists, is fallacious and full of risk of fatally infecting the peritoneum; the experience of Guersant,[28] Edward,[29] Curling,[30] Giraldes,[31] Cripps,[32] Jacobi,[33] Anders,[34] Czerny,[35] and others, uniting to prove that this is no imaginary risk. (See Fig. 1, after Cripps.) Its fallacy is also well illustrated in my own experience.

On the other hand, the exploration with probes and bougies through the bladder and vagina, with the view of feeling the resistance of the enteron in the hollow of the sacrum, is also extremely fallacious, and cannot be relied upon, though the introduction of guides into the bladder and vagina is almost a necessary preliminary in all cases, in order to facilitate the recognition of these parts and to prevent injury to them in subsequent manipu-

lations. Neither can we depend upon the external configuration of the pelvis as indicating the anatomical condition of the contained organs. A narrow, undeveloped, or distorted pelvis, may be *suggestive* of correspondingly great abnormalities within, but that is all, as we shall note further on. The only positive method of establishing the diagnosis of the real anatomical condition is by actual operative exploration of the pelvic contents. How to accomplish this will now engage our attention.

VI.

Incision or Simple Proctoplasty.

It may be said that all forms of incision have been suggested with the view of utilizing the limited dimensions offered by the very narrow perineal space of the newborn infant when born with this deformity. Amussat first practised a T-shaped incision; the transverse branch of the T running across the perineum from one ischial tuberosity to the other, the vertical branch beginning in the centre of the anus, if this existed, and extending backward in the median line to the coccyx. This was soon abandoned for the simple sagittal or antero-posterior section, which, in the male extended from the root of the scrotum (perineo-scrotal angle) to the coccyx, and in the female from the vulvar commissure to the coccyx. When the anus, or a trace of it existed the incision was then, and is now, frequently limited by the anal centre anteriorly and the base of the coccyx posteriorly. It can now be extended further backward without fixed limits according to the needs of the operator, by utilizing the sacro-coccygeal route.

The careful study of the dimensions of the infantile pelvic outlet has taught us that nothing can be gained by any cross section of the perineun as a method of increasing the field of the operation.

On the contrary, much and irreparable damage will be done by the division of the fibres of the external sphincter if these exist, as they usually do; and still more by cutting the fibres of

the levator ani, which is our main reliance in the future control of the rectal outlet. We cannot, therefore insist too much upon making all incisions in the perineum and pelvic floor strictly in the median line at whatever depth we may penetrate. By proceeding in this way we soon separate the median fibres of the levator and coccygeus muscles, pelvic fascia, and enter the subperitoneal connective tissue of the pelvis. Then begins the second stage of the operation: the search for the rectal pouch and its isolation from its surroundings.

There are certain signs which at this stage will often lead us to a prompt discovery of the rectal cul-de-sac. These are especially bulging of the perineum or at the bottom of the incision, caused by the growing distention of the rectum. If the finger is introduced into the anal depression when this exists, a peculiar sense of fulness and tension will be discovered beyond, which indicates the proximity of the intestine. The cries of the infant, aided by pressure applied over the hypogastrium, will often make this sensation more apparent. But, more often, on the contrary, the most careful examination reveals nothing except that the pelvis is very narrow and abnormally contracted. In some cases (Amussat, Vincent, Anders, *et al.*) the transverse diameter is so narrow that the tuberosities of the ischia almost touch, and it is impossible to introduce the index finger between them. This condition is not without significance or importance to the operator. In fact, some writers affirm that the defective development of the pelvis is an index to the extent of the visceral imperfection, and that in such cases the perineal operation should not be thought of, and that an iliac anus should be performed without delay. There are several cases on record which prove, however, that this conclusion is erroneous (Vincent, Anders), and, furthermore, even if the pelvic space is very narrow, there are other resources left which will amply compensate for this contraction, and will permit the operator to reach the blind end of the colon through a perineal opening, even if the rectum be totally absent. Anders, whose authority in this matter is indisputable, expresses a similar opinion, and believes that while an abnormal contraction of the pelvis is unfortunate,

and is not be lightly disregarded, it must not be permitted to influence our choice of the operation.

When the intestinal pouch fails to appear after the complete section of the skin, we must proceed with caution, and, as Durand insists, the surgeon must constantly think of three organs, the rectum, the peritoneum, and the pelvic fascia.

After the ischio-rectal fossæ have been freely exposed, the main exploration and incisions must be directed backward toward the hollow of the sacrum.

We must bear in mind that the organs of the utero-vaginal tract in the female, and the bladder in the male, have a most annoying tendency to fall backward on the sacral vertebræ, and are easily mistaken for the rectal pouch, and have been repeatedly injured.*

Therefore, when the posterior fibres of the levator have been separated and pelvic fascia opened, it is best to trust to the grooved director and the finger for the further exploration of the pelvic floor and sacral hollow. In case of doubt, a guide introduced in the vagina or in the bladder, according to the sex of the infant, will prove most serviceable. At this stage, the expulsive efforts of the child, or its cries, will often bring the exploration to a happy termination by forcing the distended rectum down into the gap, thus leading to its easy recognition.

* Kirmisson: L'absence de l'anus et du rectum en coincidence avec des malformations multiples (pouce surnuméraire, hypospadias, ectopie abdominale des deux testicules, dilatation des deux urétères, etc.). Rev. d'Orthoped., Paris, 1895, vi. pp. 284–899. In this case there was a total absence of the anus and rectum, and the pelvis was very abnormally contracted. A perineal incision was made, and the bladder presented itself in a manner which closely imitated the rectal pouch. It was opened cautiously, and the presence of urine revealed its true nature. The perineal route was then abandoned and an attempt was made to reach the colon in the left groin. Here new and unexpected difficulties presented themselves in consequence of the enormous dilatation of the ureters, which were as large as the colon. The blind end of the colon was, after great difficulties, recognized in the lumbar region, where it was hidden behind the peritoneum. Considerable traction had to be made to bring the retracted gut to the abdominal incision, and the tension was so great that the sutures tore through the bowel coats and some meconium was unavoidably spilled in the peritoneum. Notwithstanding this accident no peritonitis followed. Later, however, the bowel became detached and prolapsed through the iliac opening, leading to the death of the child sixteen days after. The anomalies in the arterial distribution of the mesenteric vessels in this case, as revealed by the autopsy, were also very extraordinary.

This tendency of the rectal pouch to descend into the outlet of the pelvis spontaneously has been made familiar to all students of this subject by the now classical anecdote told by J. L. Petit,[36] of a surgeon who, despairing that he would ever find the rectal pouch, after a most patient search gave up the case. The parents, however, sent for another surgeon, who, on his arrival, had the good fortune to find a blackish tumor protruding between the lips of the wound, which had been created by his predecessor, and which he had no trouble in recognizing as the missing rectum. This he at once punctured, and thus, without much effort, succeeded in establishing his superiority as an operator at the expense of his too easily discouraged rival.

On the other hand, this remote possibility was not infrequently made the excuse in the past for delaying further search for many hours, and led to pernicious and often fatal delays in practice.

All authors speak of a fibrous cord which sometimes connects the perineum or anal rudiment to the rectal pouch, but this is not to be relied upon; it is really exceptional, as all operators of experience attest.

VII.

The Peritoneum and Stromeyer's Suggestion.

The older operators, even up to very recent times, feared the accidental opening of the peritoneum in this locality as one of the direst of calamities, and if they insisted so formally in following the hollow of the sacrum in their punctures and explorations, it was more to avoid injuring the peritoneum than to prevent accidents to the bladder or other organs.

Their fears made them illogical; for after losing valuable time, sometimes hours, in ineffectual subperitoneal manipulations, in which the greatest caution was observed to avoid an accidental tear of the serosa, they abandoned the lower route and proceeded to do deliberately what they had been trying most strenuously to avoid, viz.: to open the peritoneum by an-

other operation, and incur the risk of its infection by creating an artificial anus in the groin.

The inguinal colotomy which was performed under such circumstances was always more dangerous than if performed as an initial operation, the operator being pressed for time by the exhaustion and threatened collapse of the patient from the tedious and bloody traumatism that preceded it. The risk of peritoneal sepsis was also greater, owing to the hurry with which the suturing of the bowel to the skin had to be effected. This inconsistency did not escape the observant mind of Stromeyer, who for the first time, in 1844, expressed the opinion that if the rectal pouch could not be found after a careful subperitoneal search in the perineal wound, it was proper to open the peritoneum in the pelvic floor in order that its relations to the other pelvic organs be more satisfactorily investigated and the presence of the missing rectum ascertained.

Stromeyer's operation,[37] as the Germans call this procedure, was never performed by himself, but Leiserink[38] applied it for the first time in 1872, and obtained a brilliant result. The case was that of a male infant, born imperforate. Leiserink failed to discover the rectal cul-de-sac. Through the perineal opening the finger was introduced into the cavity of the peritoneum, and the dilated end of the colon was recognized by the finger at a depth of seven centimetres. The colon was then seized with blunt forceps and dragged down to the opening, where it was sutured and opened. Some signs of local peritonitis followed, but the child made a rapid and easy recovery. In 1879, Krönlein[39] reported a very instructive case, in which he deliberately opened the peritoneal cavity through the perineal incision. The child was seven days old and in bad condition. A perineal incision in front and behind the anal depression was made, which was carried to the depth of three inches without meeting the rectal ampulla. The peritoneum was then opened, and a considerable quantity (120 grms.) of ascitic fluid escaped. The finger then introduced in the cavity failed to find the missing cul-de-sac, and left iliac colotomy was attempted. Here, again, the close adhesion of the colon to the lumbar region prevented

the operator from bringing it to the surface, and he was compelled to attack and open *the nearest and most distended coil of intestine*. The infant recovered. Seven months later the finger was introduced into the artificial anus, and a resisting body was felt in the pelvis which was suspected to be the distended rectum. The perineal scar was reopened and Krönlein was fortunate enough to find that the distended rectal pouch had since the operation descended into the pelvis. A perineal anus was now formed, and the child recovered completely in three weeks.

Anders,[40] on June 3, 1881, availed himself of Stromeyer's suggestion, and successfully performed a proctoplasty by pulling down the blind rectal pouch, which he had found high in the pelvis, to the perineal opening. In three weeks the child had entirely recovered.

In a preceding case in which Anders had utilized an accidental tear in the peritoneum to localize the position of the rectal pouch, the child succumbed from exhaustion forty-eight hours afterward. The autopsy satisfied him that there was no peritonitis.

Vincent,[41] of Lyons, (1886–87, Maitre's thesis), opened the peritoneum, through the perineal wound, in two cases. One of these was a particularly trying operation, in which, after a thorough exploration of the pelvis through the perineum and sacral region, it was found that the rectum was entirely absent. Vincent then decided that instead of inflicting the additional shock of a laparotomy he would pull down the sigmoid colon and bring it to the sacral opening. He was able to reach the iliac fossa readily, and pulled down a distended gut, which happily proved to be the blind terminal portion of the colon, which was sutured and opened at the parasacral opening, which the operator had made high, in accordance with his special method, which will be referred to later.

A. Mayo Robson,[42] of Leeds, also reported a case (1886–87) in which the peritoneum was deliberately opened and the cul-de-sac of the colon thus recognized and sutured to the peritoneum without any evil after-effects. Robson suggests that a

uniform principle or plan be adopted in operating imperforate anus, in which he urges the advantages of the perineal exploration, made more universally applicable by the aseptic opening of the peritoneum.

H. Cripps also reports the following (*British Medical Journal*, June 4, 1892, vol. i. p. 1892): A male infant, three days old, was admitted August 14, 1890, with imperforate anus, also with hypospadias. There was considerable bilious vomiting. A cul-de-sac reached from the anus upward for about one and one-quarter inches. There was no bulging to be felt, though the abdomen was somewhat distended. A median incision made from the anal cul-de-sac back to the coccyx, and the bowel was found after dissection of one and one-half inches upward. The peritoneum was extensively opened, but was closed by five silk sutures. After the bowel had been drawn down the child did well, and was brought to the surgery daily for six weeks to have a bougie passed.

A. Joudeau[43] (1891) reported a case in which Stromeyer's suggestion was applied. Male infant, five days old. Anus well formed. Attempt at proctoplasty by the perineal route. Failure to find the rectal pouch. Peritoneum opened and pelvis explored by perineal incision; still no rectal ampulla was found. The operator was about to perform a Littré when the extreme weakness of the child decided him to pull down the first distended loop of the bowel that he could secure and stitch it to the perineal wound. After doing this and giving exit to the meconium immediate relief followed, but death took place in thirty-six hours from exhaustion.

Other operators have no doubt had similar experiences, though I fail to find other references which illustrate the practice of this procedure in the current literature of the subject. There are probably many unrecorded cases which would illustrate this practice in the last few years, especially since, as Mr. Tait has said, we are able to open the peritoneum with almost as little fear as we would our pockets. It is certain, however, that the systematic application of Stromeyer's suggestion, which could only have been realized since the advent of Listerism, is an-

other and most conspicuous landmark in the history of the treatment of these malformations, and will revolutionize our hitherto classical modes of treatment. Until very recent times —in fact, in several late text-books—the instructions are still given that after penetrating to a certain depth in the perineum the search for the missing rectum must be abandoned and colotomy must be performed. Some of the ancients insisted upon a limit of penetration of one or one and one-half inches (Copeland Hutchinson, for instance). Then only the trocar could be used; but as surgery grew bolder the limit of exploration was allowed to extend two, three, four, five, and even six centimetres in depth. Anders (1893), in criticising Jacubovicz (1886) for stating that in general an exploration beyond the depth of four or five centimetres is dangerous because of the probable injury to the peritoneum, says that he has frequently penetrated eight or nine centimetres into the pelvis (presumably through the peritoneum) in his own cases without ill effects. The active propaganda in behalf of early intraperitoneal exploration of the pelvic cavity for the missing enteron in cases of imperforate anus, which was started by Stromeyer and long afterward continued by the work and advocacy of Liesrinck,[44] Krönlein,[45] Anders,[46] Vincent,[47] Froelich,[48] Fochier[49] and Commandeur,[50] Durand,[51] Robson,[52] and others, will no doubt rapidly reach the mass of the profession and generalize the new procedure as occasion calls for it. At any rate, it is not likely that we shall read many more accounts of those prolonged manipulations, so exhausting to the patient and operator, and which the French have picturesquely described as "foraging" (*forage*) or "mining" (*travail de mine*), and which were, in the main, due to the dread of the peritoneum. And the questions, "When shall we stop?" and "To what extent ought we to persevere with the exploratory dissection of the deep perineum and parasacral region before proceeding to colotomy?" will not remain long unanswered, as no precious time will be lost in unnecessarily long and uncertain subperitoneal manipulations.

Stronger, however, than the evidence gathered by the com-

paratively rare and isolated experiences in this class of cases is the convincing argument of modern gynecological experience, which demonstrates by hundreds of cases of vaginal hysterectomy for cancer, for fibroids, for tubal and ovarian disease, that the peritoneum is even more tolerant of trauma and less liable to septic infection in the pelvis than when attacked by the higher hypogastric operations. The lessons gathered from the more general experience of abdominal surgery cannot be lost, and their application to this more restricted field of intestinal work must soon yield better fruit.

VIII.

Presuming that in a given case we have succeeded in finding the blind terminal pouch of the rectum and colon, and have dragged it gently to the edge of the peritoneal wound with a protected or blunt artery-forceps or the fingers, the distended gut will present itself in two ways: (1) either free from serous coverings, which will be observed in those simple cases in which the rectum has nearly reached the perineum in its development; or (2) as a pouch partially or entirely covered by peritoneum, which will be the case when the intra-peritoneal method has been called into requisition, and when the gut has been arrested in its developmental ascent at a high point in the pelvis. In either case, great care must be taken to avoid the septic contamination of the perirectal tissues. The danger of sepsis from fecal contact must be proportional to the number of hours that have elapsed since the birth of the infant, for, as Welch[58] and others have shown, the meconium is bacteriologically sterile at birth, but is bound to become septic by admission of germs in the ingesta and by other means, even when the child is breast-fed. As it is not likely that the meconium will maintain its asepticity many days, or even hours, after birth, it is proper that in all cases the operation of opening the sac should be conducted as if the meconium were septic. If the peritoneal cavity has been opened it must be carefully protected, as if we were opening the colon in the groin, by packing sterile gauze

around it, and, if there is great tension, a preliminary tapping may become necessary as Esmarch[54] and others recommend as an invariable procedure. But the safest plan in all cases in which it is practicable to do so is to carefully suture the gut to the deeper planes of the peritoneum or of the perineal wound, by either a protecting row of buried sutures or by the method of Vincent,[55] who introduces deep fixation-sutures through the skin and soft parts which penetrate deeply into the rectum at a distance from the anal margin. The ends are knotted without overtension. Vincent applies several of these sutures at equidistant points in the periphery, with the double object, first, of firmly anchoring the rectum, and, secondly, of protecting the deeper parts of the wound from fecal contamination.

After the deeper tissues are protected the cul-de-sac can be punctured or incised freely. It will always be a safe precaution, as well as a source of relief to the infant, to keep a continuous stream of warm and mildly antiseptic fluid constantly flowing over the field of operation. After the evacuation of the gut has been accomplished the mucosa must be carefully adjusted to the skin in order to complete the proctoplasty. Here I believe that Vincent's suggestion to cut two elliptical flaps of skin, when *the anus does not exist*, or when the new orifice has to be placed at a higher point than normal, is a valuable recommendation. The excision of these elliptical flaps increases the area of denudation, and allows the rectal mucosa to be spread over the margin of the wound, like the borders of a large felt hat ("Rebord de chapeau"), and favors prompt union over an extensive surface, and insures a most complete protection against a cicatricial retraction. Finally, a carefully made interrupted silkworm or silk suture brings the edges of the mucosa and skin in linear coaptation and completes the operative act. Bismuth and iodoform mixed is an excellent dressing powder, but the greatest reliance must be placed on frequent warm baths, which are fortunately easily applied throughout the after-treatment. In other respects the treatment should be conducted on general principles.

IX.

The Anal Infundibulum (Proctodeum); its Treatment.

We have thus far considered only those relatively simple cases in which the rectal pouch is easily discovered by extra-peritoneal or intra-peritoneal incision and manipulation, and is readily dragged down to the perineal wound. This easy termination of the operation is, however, far from being the invariable rule, for, as we all know, often more serious and trying complications combine to thwart the purpose of the operator. Before proceeding further it will be convenient to consider the question, whether we should always avail ourselves of the anus and its cul-de-sac (the "anal thimble") and allow these to remain undisturbed when they exist? In simple cases it is unnecessary to increase the traumatism and complicate the operation by its excision, especially when all that may be required to restore the continuity of the recto-anal tract is to perforate a thin membranous partition, which alone interferes with the escape of the meconium. But, unfortunately, in the majority, this is not the case, and the infundibulum of the rudimentary anus is an impediment to a perfect proctoplasty, and must be sacrificed, though its excision must be done in a manner that will respect as closely as possible the subjacent tissues, and, especially, the muscular fibres of the sphincters, if these exist.

When the rectal pouch is short and terminates too far from the natural opening to permit its fixation at the normal anal orifice, the only alternative is clearly to create the anus at the lowest possible point, and leave the original proctodeum without disturbance. But when the rectal pouch has been freely dissected from its surroundings, and is rendered flaccid by the evacuation of its contents, it is not only long enough to reach the normal anal margin, but leaves a redundancy of mucous membrane, which may even exceed the amount required for a perfect plastic.

In my patient's case I was anxious to disturb the superficial perineal fibres of the sphincter as little as possible, and pre-

ferred to leave the cul-de-sac *in situ* after suturing it to the rectal pouch in the manner shown in the diagram. (Fig. 2.)

While the procedure is perfectly feasible and is apparently satisfactory, I believe it is a better plan to entirely remove the mucosa of the anal cul-de-sac down to its junction with the skin by a careful dissection, and substitute for it mucosa of the enteron. The objection to lateral entero-proctorrhaphy, as we might designate the suture of the bowel to the rudimentary anus, as practised in my case, is that it leaves a larger anal orifice than is required, and that the interposition of the new mucosa in the posterior segment will act as a wedge, and will interfere with the perfect grasp of the sphincters. On the other hand, the circular suture of the dilated enteric end to the dome of the anal cul-de-sac by a circular enterorrhaphy is not always a satisfactory procedure, owing to the great difficulty in securing the accurate coaptation of the dilated end of the enteron to the narrow circle of the proctodeum. A better procedure is the excision of the anal infundibulum, leaving the marginal anal mucosa intact, and suturing it to the rectal pouch at this edge.

The fear that incontinence may follow the formation of the new anus need not cause uneasiness, as experience teaches that even when in inguinal colotomy, or in the high anal openings formed after Vincent's and Kraske's operations, to which we shall refer later, the functional control of the new anus is sufficiently good to permit the patients to live comfortably and attend to their occupations in after years without great disadvantage. When the anus can be placed in its proper normal position, and the fibres of the sphincter have been divided posteriorly only, and the levator muscle has not been cut transversely, the functional control is then perfect.

X.

The Question of Sphincter Control.

In the earlier days of the perineal operation the question of sphincteric control led to many discussions, which have been again revived in our days, in consequence of the frequent ex-

tirpation of the rectum and anus for cancer or other conditions. There is a great difference in the conditions when extirpation of the rectum and anus is made in the adult for malignant disease and when an artificial proctoplasty is made in the perineal region in the newborn fœtus. Amussat[56] paid no attention to the external sphincter apparatus in this class of cases. His theory was "that the interior outlet of the body is disposed in such a manner, independently of its muscular apparatus, as to favor voluntary retention of feces." He was supported in these ideas by Obeirne's theories (1834–35), and, as Bodenhammer remarks, by the fact that many patients have been known to regain control over their alvine discharges after extirpation of the rectum. In accordance with his own views, Amussat had no hesitation in making cross sections of the perineal region or of creating the new anus in the coccygeal region when it was too short to be dragged to its natural situation. Blandin[57] (1832) concluded from his dissections that when the anus is completely absent that the sphincter muscle is also missing, and he used this as an argument in favor of establishing artificial anus in the groin, as an artificial anus in the perineum, destitute of sphincter, would occasion incontinence of feces to a greater extent, and would be attended with greater inconvenience than one established in the abdominal wall. Tungel[58] (1863), and Velpeau[59] (1847) agreed with Blandin's anatomical ideas. Roux de Brignoles, however, was the great opponent of all these teachings. His operations were distinguished by the great care with which he sought to preserve the sphincters. He based his opinions on his dissections, which, he said, confirmed the then current theories of the errors of development of the rectum in these cases, the defects being accounted for by the abnormal distribution and formation of the inferior mesenteric arteries, which, being absent or defective, were unable to supply the rectum. The perineal muscles, on the other hand, were supplied from an entirely different source, and, unless their special vascular supply was interfered with, they suffered no atrophy, and remained functionally active.

Bodenhammer, who summarized all the prevailing opinions

up to 1860, wisely concludes that whether "the muscular fibres are present or not, the artificial anus should always, if possible, be established in the natural situation in the perineum; for should these muscles be absent the infirmity is greatly lessened, and should they be present the operation should be so especially conducted as by all means to preserve their function for the benefit of the newly-formed anus."

With the rapidly accumulating experience of the last decade, the fear of incontinence from injury to the sphincter and levators has not diminished in the surgery of the adult, and the chief concern of the modern generation of surgeons who are engaged in rectal operations appears to be how to devise means by which the fecal control that has been lost after necessary operations on the anus can be regained.* The numerous and ingenious operations for the reunion of the sphincter after complete perineal laceration and after excision, and the late suggestion of Willems,[60] Witzel,[61] Gersuny,[62] Delorme,[63] and others, prove that the danger exists, and is one of the gravest that we are confronted with in rectal practice. It is otherwise in the surgery of the newborn. Here time and long experience have taught us that nature is more capable of greater adaptation than in adults, and that in the young child the original defects of development are subsequently compensated if art will only give a helping hand in accomplishing her purpose. My own experience, limited as it is, confirms this view, and the numerous reports of cases collected by Anders and others demonstrate that the ordinary proctoplasty performed in cases in which there is no rudiment of anus is followed by a perfectly functional result.

There is no doubt, however, that the further away we move from the perineal region the more difficult it is for nature to establish control; but even here, as a considerable array of

* One of the reasons why Kraske's procedure appeals so strongly to the surgical mind is that it often permits the removal of a diseased rectum without injuring the sphincter—a desideratum which was long ago expressed and attempted by Delpech, Lisfranc, Dieffenbach, Hahn, and Koenig, after excision of rectal cancer, before Kraske or Bardenheuer had called attention to the sacro-coccygeal operation.

witnesses will attest, from the earliest reported cases,* a compensatory hypertrophy of the muscular coat about the new mucous orifice may develop into an efficient muscle, which, as the child grows, becomes more highly differentiated, and acts as a true and serviceable sphincter.

XI.

Dismissing for the present the important question of sphincter control, we must now consider the graver problems that confront the operator when he finds (1) that he cannot reach the missing rectal pouch by the ordinary perineal opening; or, when (2) having discovered it, he finds that it is impossible to drag it down without laceration to the perineal wound. It is in trying to solve these two problems that the modern generation of surgeons has chiefly distinguished itself and has added new resources to the older methods.

We have already referred to the abnormal shortening of the diameter of the pelvic outlet in many of the children born with anal imperforation. A careful study of the dimensions of the normal and abnormal pelvis has been made by several observers. Bodenhammer (1860), Maitre (1887), Froelich (1894), and others have studied the surgical anatomy of the pelvis with a view to its dimensions.

According to Maitre, who studied this question with some care, the measurements are as follows: From the root of the scrotum to the point of the coccyx, average distance is from 4 to 4½ cms. in boys, and about 4 centimetres from the posterior vulvar

* Nothing is more conclusive on this point than the reports of the earlier operations for the relief of imperforate anus by primary inguinal colotomy which were reported by Duret,[64] Miriel,[65] (Pere et fils), and many others, subsequently collected by Rochard,[66] Bodenhammer,[67] Giraldes,[68] Cripps,[69] and others, which demonstrate that patients afflicted by this infirmity have lived to a mature old age in perfect comfort and in the enjoyment of all the privileges of the normal individual. A striking case, which contradicts some of the pessimistic ideas entertained on the distressing features of colotomy in imperforate children, by those who are not familiar with the literature on the subject, is a patient of Prof. Ollier, of Lyons, reported by Laguaite in his thesis.[70] In this case inguinal colotomy was done for imperforation. The girl grew to womanhood, suffering no inconvenience from her abnormality, and, at the time of the report, was *en voie de mariage*.

commissure to the coccyx in girls. According to Froelich's measurements, 3 cms. would be nearer the true average. The distance from the anus to the tip of the coccyx would average 1 to 1½ cms. This measurement appears to be a little greater in males than in females.

The distance of 1½ to 2 cms., which normally separates the ischial tuberosities does not appear to differ much with the sex. The field of operation resembles a lozenge with a diagonal length of 3 or 4 cms. We must now add to this that the distance from the tip of the coccyx or from the centre of the anus to the most salient point of the sacro-vertebral prominence is 5 to 6 cms. In the male, the recto-vesical cul-de-sac of the peritoneum lies at 3 cms. above the anus, and in the female the recto-vaginal cul-de sac averages 2½ cms. from the anus.

According to Froelich, Maitre's figures would be a little above the average. He measured the distances in five newborn babies at the maternity of Nancy, and found that the recto-vesical cul-de-sac rested no further than 2 cms. from the anus when he took the anterior anal margin at its junction with the skin as his lower landmark. From this point to the sacro-vertebral prominence in the male the distance averaged 5½ cms. We must now bear in mind that these are normal dimensions, such as are found in newborn infants at term. In cases of imperforate anus we must expect to find frequent narrowing of the outlet, especially in its bis-ischiatic diameter, while the depth of the pelvis may be very much increased. In one of Vincent's cases the distance between the tuberosities was only 10–12 millimeters.*

* The following measurements were obtained by the author (April 30, 1897) from a normal stillborn full-blooded negro fœtus, at term weighing about eight pounds:

1. From the posterior commissure of the vulva to the tip of the coccyx, 3½ cms.
2. From the posterior margin of the anus to the tip of the coccyx, 2 cms.
3. Bis-ischiatic diameter, 2½ cms.
4. Distance from sacral spine to tip of coccyx, dorsal measurements, over soft parts, 5 cms.
5. Length of sacrum, dorsal surface, 2½ cms.
6. Length of coccyx, 1½ cm. (Both of these last measurements confirmed by dissection.)
7. Distance from the upper border of the sacro-sciatic notch to line of base of sacrum, 2 cms.
8. The index finger introduced into the rectum explored the entire pelvis up to the

In dealing with the surgical anatomy of the part it will be well to remember that the enteron or rectal pouch, as it is arrested in its various stages of development may assume certain relations to its peritoneal investment that are variable within wide limits. Even when the bowel descends low down as far as the coccygeal region, it forms a projecting pouch, which is covered by serous membrane except in its posterior surface. This is the reason why, as Cripps has well shown, many cases of simple puncture with a trocar have ended in peritonitis through contamination of the peritoneal cul-de-sac, which intervenes between the anal centre and the rectum. (Fig. 1.) When the enteron is arrested higher up at the middle of the sacrum, it is still more thoroughly invested by peritoneum, and this accounts for the frequent accidental tearing of the peritoneum, as in my own case, and in the experiences related by Curling, Guersant, and several others. When the gut stops at the promontory of the sacrum it is then usually provided with a complete mesentery, and the distended bowel hangs loosely in the pelvis precisely like the cæcum does normally, and it is impossible to reach it

sacro-vertebral junction as far as a point 10 cm. above the anal margin, along the line of the spine.

9. The finger introduced into the anus 6–8 cm. easily touched the vertebro-sacral prominence, and swept readily over the superior brim to the pelvis.

10. The posterior cul-de sac of the peritoneum was reached at 2½ cm. from the anal margin.

Exploration above the pelvic brim into the iliac fossa was much facilitated by flexing the vertebral column and tilting the pelvis in an extreme lithotomy position. The anus and rectum are easily dilated, and yield without laceration to the index finger of the operator. After dissection it was found that the coccyx was entirely cartilaginous. The sacrum was also cartilaginous up to the third sacral vertebra, and could be cut to any extent up to this point with a pair of common dissecting scissors. Above this point there were centres of ossification which would have required a heavier pair of scissors or a rongeur forceps, if further excision of the sacrum to its base had been contemplated.

After removal of the coccyx and the sacrum up to the third sacral vertebra by a median incision, the opening made easily permitted a complete palpation of the rectum up to the beginning of the sigmoid flexure. The ileum and other coils of small intestine could also be dragged to the wound, where they could have been readily opened had an artificial anus been required. The vagina, uterus, and appendages, could easily be brought to the external wound; the bladder could also be easily palpated and inspected through this aperture. The facts obtained by the examination of this normal fœtus were eminently suggestive of the possibilities of the sacral route in the class of cases under consideration, and were confirmatory of the experience already obtained with Kraske's method in the adult.

without going through its serous coverings as Debout (1885), Delagenière (1894), and others have demonstrated by actual dissections. With these facts before us we can easily understand the ease with which septic contamination of the serosa takes place when deep dissections are made in the pelvis with the view of reaching the enteric pouch subperitoneally.

XII.

Procedures Suggested with the View of Increasing the Antero-posterior or Saggital Diameter of the Pelvic Outlet.

First among these we must mention, in chronological order, the removal of the coccyx, or a part of it, as suggested by Amussat in 1834, and applied by him in a case reported on November 28, 1835. We have already sufficiently explained Amussat's operation and the reasons which led him to extend his perineal incision to the coccygeal region.

This suggestion of Amussat, which really entitles him to the credit of being the father of the sacral route, appears to have been forgotten by the French themselves. They usually refer to the excision of the coccyx as an original suggestion of Verneuil,[71] who, though himself most conscientious and learned in historical matters, appears to have overlooked Amussat's undoubted claim to priority, for he does not mention Amussat's case or his suggestion in his first exhaustive paper before the Société de Chirurgie de Paris, in 1873, and entitled "The Resection of the Coccyx to Facilitate the Formation of a Perineal Anus in Cases of Imperforate Rectum." He states that the value of coccygeal resection had occurred to him as far back as 1853, when practising Amussat's simple proctoplasty on the cadaver, etc. He thus refers to Amussat's simple perineal incision without alluding in any manner to Amussat's coccygectomy, which Verneuil evidently considers his own idea. Bodenhammer, however, in 1860, long before Verneuil published his memoire of 1873, had made English readers familiar with Amus-

sat's prior claim in this direction, so that American and English writers have occasionally referred to coccygeal resection in these cases as Amussat's operation, while the French have been steadily designating it as Verneuil's. I have lingered over this point because the resection of the coccyx unquestionably marks the first step in the evolution of Kraske's sacral resection. It is undeniable, however, that it is due to Verneuil's enthusiastic advocacy of this procedure, and the brilliant results which he obtained by this means, that the suggestion was revived, especially in France. Kocher,[72] of Berne, in 1874, and Lange,[73] of New York, 1883, also independently practised coccygectomy, in order to gain a more ready access to the pelvis while extirpating rectal carcinoma; but the credit remains with Verneuil for having familiarized the modern generation with the value of this procedure in congenital and rectal imperforation. Verneuil advised the early excision of the coccyx by prolonging the median perineal incision over this bone, which he enucleated with great care, so as not to injure the muscles and soft parts that were attached to it. There is no doubt that this can be done without seriously disturbing the tendinous attachments of the sphincter, coccygeus, and levators, and is a most valuable means of enlarging the field of the operation. Even when this is not absolutely necessary, says Verneuil, the performance of coccygectomy at an early stage of the operation greatly expedites its termination by bringing the enteron easily into view and by facilitating its fixation to the wound without tension.

Simple coccygectomy (*i. e.*, not combined with sacrectomy) has not been performed very often, for after a patient search I have been able to gather only sixteen reported cases (up to July, 1897). These cases will be found tabulated in the accompanying table. They are all serious cases, for the fact that they necessitated the removal of the coccyx indicates that the rectal pouch was situated high up, and was inaccessible by the ordinary perineal incision. This accounts for the heavy mortality, 60 per cent., which, I am satisfied, is not in the least attributable to the excision of the coccyx. This bone is cartilaginous in the newborn, and its rapid excision can be effected with sharp heavy

scissors. I can confirm Verneuil's statements when he says that the excision of the coccyx so greatly facilitated his exploration of the pelvis that he was usually able to find the rectal pouch in a few minutes, whereas, he had lost in previous cases one-quarter of an hour or more in a fruitless search by the simple perineal incision. Though not regarded with favor by Esmarch, Anders, and others, there can be no question that the Amussat–Verneuil suggestion is a decided help in many cases and an improvement over the old methods. An objection to coccygeal incision, which has become more apparent since sacral operations have been more frequent, lies in the predisposition to prolapse of the rectum which it induces, and to which we shall refer in another place.

In connection with coccygeal excision, we would refer to two other suggestions, viz.: the perineal incision extended through the middle of the cartilaginous coccyx without extirpation, as successfully practised by Polaillon[74] (1875). Delens[75] (1874) suggests that this bone be displaced backward without removing it, as successfully done by himself, and since by Esmarch, Anders, and Hawkes.[76]

Incidentally we would state that Byrd,[77] of Quincy, Ill., was the first to apply coccygectomy in this country, in a successful operation for imperforation in 1880. He credits Verneuil entirely with the suggestion.

(We shall again refer to the results obtained by simple coccygectomy when reviewing the tabulated cases presented in Table I.)

XIII.

Resection of the Sacrum.

Nothing was more natural after the extirpation of the coccyx than to advance a step further when great difficulties presented themselves in the way of reaching the dilated rectal pouch, or of attaching it to the skin, than to increase the gap in the pelvis by sacrificing a part of the sacrum. Nevertheless, the important and close relation of this bone to the sacral nerves and vessels,

and the fear of opening the sacral canal, caused this osseous barrier to be respected until very recent times. In fact, it was not until the feasibility and advantages of sacral incision had been proclaimed and demonstrated by Kraske[78] in his papers of 1885, 1886, 1887, and the isolated experience and opinions of previous operators like Bardenheuer[79] (1880), and the antecedent work done in coccygectomy, aroused serious interest in the sacral route as a legitimate procedure. Then followed the numerous repetitions of Kraske's operation for the relief of cancer by Rinne, Israel, Schonbron in 1886, and subsequently by Bardenheuer, Schede, Lauenstein, Bruns, Koch, Roux, Levy, Hochenegg, Heinecke, Rydygier, Rhen, with other various and more or less valuable modifications with which we are acquainted. Then came the application of Kraske's suggestion to gynecological practice by Hegar and Wiednow in 1889, and later by Pozzi, Terrier, Routier, Richelot,[80] for removal of the uterus and appendages in advanced cases of diffused malignant disease. Then other operators have followed with numerous observations, so that in a little over a decade hundreds of observations have accumulated which eloquently attest the high estimate placed by the profession upon the value of this new procedure as a more direct avenue to the pelvic viscera.

XIV.

Application of the Sacral Route to Congenital Ano-rectal Imperforation.

Notwithstanding numerous precedents and the great activity displayed in all countries in the application of Kraske's operation to the rectal and pelvic surgery of the adult, we find that it is only very recently, indeed, that resection of the sacrum has been adopted in difficult cases of imperforate rectum. The first published records that I can find in which the sacral route was utilized are mentioned in the thesis of Maitre, of Lyons, which appeared in June, 1887, and were gathered from the clinics of Prof. Vincent, of that city. Vincent's cases[81] were also reported

to the Société Nationale de Médecine, of Lyons, March 14, 1887. Morestin, in his remarkable and exhaustive thesis on Kraske's operation, published in 1894, devotes a short chapter to the possible applications of the sacral route to the surgery of congenital imperforations and defects, and refers to the extensive resections practised by Kraske and Bardenheuer in adults, but fails to mention Vincent's or any other cases. As Kraske, in his three papers, and Bardenheuer (1887), and Anders (1893), who is thoroughly familiar with the literature of the subject, do not report any actual applications of this method to this class of cases, and after carefully examining the references in the *Index Medicus* to the present date (August, 1897), I conclude that Vincent was the first, in 1887, to attack the sacrum for imperforation. As we shall see, however, Vincent, as he is represented by his pupil Maitre, preferred sacrotomy and parasacral incision to sacrectomy, and now favors the parasacral incision altogether, which he believes accomplishes all the purposes of sacro-coccygectomy, without permanently damaging the pelvic skeleton, and with less shock to the patient.

We shall now pass in review the individual cases in which sacro-coccygectomy or the sacral route has been applied for the relief of congenital imperforation as a preliminary to a final estimate of the value of the operation.

The following is an abstract of Vincent's cases in which the sacral route was adopted by himself and Mâitre.

Case I. September, 1887. Male infant, aged 24 hours. Complete absence of anus. Operated at night. Meteorism beginning. No bulging of perineum. No meconium in urine. Lithotomy position. No anæsthetic. Median perineal section, 5 to 6 centimetres, from root of scrotum to tip of coccyx. No pouch in depth of perineal wound. *Peritoneum purposely opened.* Bladder presented and recognized by catheter. Coccyx cut in half, and sacrum divided up to its middle portion (*milieu de sa hauteur*). The parts are then retracted laterally, and the ampulla is recognized, seized with forceps and gently guided to the surface. Anus permanently fixed and opened at a point 4 cms. from the scrotum at the junction of the sacrum

and coccyx. The new anus admits thumb easily. Child died October 3d, apparently from causes independent of operation.

Case II. Vincent, of Lyons, April 27, 1887. Male, aged 38 hours. No anus; pelvis contracted; ischial tuberosities only 10-12 millimeters apart. Perineal incision and immediate resection of coccyx, as there is no working space in perineum to reach guide in bladder. Coccygeal incision carried high up along left border of sacrum to the highest level of the sacro-sciatic notch. Peritoneum opened. Careful exploration of pelvis discloses total absence of rectal pouch. The finger introduced above the superior pelvic strait into the iliac fossa, and a bowel, which Vincent takes to be the sigmoid colon, is brought down. Closer examination reveals that it is the terminal pouch of the colon held by mesentery. It is brought down and stitched to the upper limit of parasacral wound at the highest level of the sacrosciatic notch. Three days after, child dies of exhaustion. Autopsy shows no peritonitis. The rectal pouch firmly attached and adherent to skin, and no damage done to parasacral structures.

Case III. Ceci, of Genoa (*Operazioni sul retto*, 1891, p. 14), describes a case of atresia ani successfully operated by Bardenheuer's method of sacral resection, March 30, 1890. Male infant, aged two days, well formed. Distended abdomen, anal orifice normal, terminating in a blind pouch at a depth of one centimetre. The anal cul-de-sac was freely incised up to the level of the tip of the coccyx. A catheter introduced in bladder revealed that the pelvis was occupied by the bladder and urethra. Incision then prolonged *upward to the middle of the sacrum*. The coccyx and the sacrum were exposed, the sacrosciatic ligament was divided, and the sacrum cut transversely on a level with sacrosciatic notch and removed with the coccyx. The parasacral tissues were retracted in the median line and carefully separated with a blunt director in the direction of the hollow of the sacrum, with the catheter acting as a guide.

After dissecting for a depth of 3 or 4 cms. the rectal ampulla was identified as a very thin-walled, almost transparent, pouch. This was isolated with great care, and was finally brought down to the upper border of the normal anus, where it was finally

sutured and incised. An abundant flow of meconium followed. The posterior anal margin and coccygeo-sacral wound were closed with metallic sutures. The child recovered rapidly, and was entirely well, when a capillary bronchitis set in and carried it off on the seventeenth day after the operation. (Quoted by Sieur, *Archives Provinciales de Chirurgie*, March 1, 1897, p. 185.) In this case the following points are worthy of notice: the extensive sacral resection, the position of the rectal pouch high above the pelvic floor, the successful suture of the rectal ampulla to the sacral cul-de-sac.

Case IV. was operated by H. L. Burrell, of Boston, November 24, 1891, and has been recently reported by F. A. Higgins (*Boston Medical and Surgical Journal*, May 14, 1896, No. 20, pp. 485, 486). Male, aged four days, general condition good, though abdomen tender and distended. Anus formed and admitted the tip of a little finger to a depth of nearly an inch and a half. A sense of fluctuation was imparted to the finger. Median incision from the posterior margin of anus to dorsum of sacrum. The coccyx and left half of the sacrum up to the second foramen were excised with bone-forceps. An opening of sufficient size was thus obtained, with the rectum lying exposed directly in front. The rectal and anal portions of the intestine were continuous, and the obstruction found to be due to a membranous diaphragm stretched across, about two inches above the anal opening. The anus dilated, the diaphragmatic partition punctured from below, the opening stretched, and the external wound was sutured. The punctured diaphragm was dilated every three or four days while the child remained in the hospital. Recovery was uneventful. Discharged from the hospital on the tenth day. The boy was four years old when the report was published, is now perfectly well, and has perfect control of the sphincter.

Case V. is reported by Chaput (*Des operations sur l'intestin, etc.*, Paris, 1892, p. 131). The date of the operation is not stated, nor the age of the infant. The operator says: Failing to reach the gut by the perineum, a vertical incision was made in the left iliac fossa. The sigmoid flexure was then

sutured to the abdominal wound, as in colotomy, and opened. A probe was introduced down to the rectal end of the bowel, and an effort was made, but unsuccessfully, to make the rectal pouch project at the perineal wound. The coccyx was now excised, and 1 or 2 cms. of the sacrum resected. After this the tip of the probe was felt through the walls of the bowel in the perineal wound, and then the pouch was incised. But it was still found impossible to drag the mucosa to the skin, probably because of the previous anchoring of the sigmoid colon in the inguinal wound, where it had been sutured. To prevent the obliteration of the inferior orifice, a rubber tube was inserted in the rectum and made to come out through both the inguinal and perineal openings. The child recovered from the the operation, but died in two months from neglected diarrhœa.

Chaput remarks that when the ordinary perineal incision is insufficient either to recognize or to create a lower pelvic outlet for the gut, this may be done by extending the incision to the sacrum.

Case VI. was operated by Poisson, of Nantes, in 1892 (*Soc. Med. de Nantes*, Dec. 15, 1895, quoted from Sieur, *loc. cit.*) Female infant, age not stated, anus well formed. The anal cul-de-sac is 2 cms. deep, at the bottom of which a bluish membrane is recognized as a diaphragm by means of an anal speculum. The family physician made an incision of 2 mm. in depth, but no meconium escaped. The next day Poisson made a deeper incision, and was able to introduce a gum catheter a distance of 15 or 20 cm. in depth. A little serous fluid escaped through the catheter, and the operator supposed that he had penetrated the peritoneal cavity. Kraske's operation was then adopted. The posterior perineal raphé was incised throughout its thickness, and the coccyx, with 2 or 3 cms. of the sacrum, were removed.

The bowel was now readily recognized through the incision, and was brought out to the level of the skin, where it was incised and sutured. The operative sequelæ were of the simplest kind, with the exception of a procedentia of the rectum, which was reduced permanently (?) by iodoform packs.

Sieur, in his commentary upon this case, says: "We would only criticise M. Poisson's operation in one respect, and that is: that he did not try to utilize the existing anal orifice, and thus obtain a complete restitution *ad integrum*, as was done in Ceci's case." This criticism would also partially apply to my own case (to follow), and others, but the reply is that complete entero-proctorrhaphy is not always a simple procedure, and is likely to be followed by stricture. It would be preferable, as stated elsewhere, when the anal cul-de-sac cannot be readily sutured to the enteron, that it be entirely removed by careful dissection, with proper regard for the muscular fibres, and that the mucous membrane of the enteron be substituted in its place.

Cases VII. and VIII. were reported by Czerny (Heidelberg), at the Twenty-second Congress of German Surgeons, held April, 1893. The precise date of these operations is not given in the abstract of the proceedings. In speaking of Kraske's operation, Czerny says: "I was less fortunate in two cases of atresia ani in which the ordinary perineal incision, which was first tried, did not attain the good desired. In one case the atresia recti was about 2½ cms. above the anal opening, and in the attempt to operate by the perineal route I could not find the intestine. In this case, for the first time, I did an osteoplastic operation, resecting the os sacrum and the os coccyx according to the method lately recommended by Rydygier, and even before him by Rhen, which is as follows: first, a left para-sacral incision, then a cross incision at the level of the fourth sacral vertebra, then chiselling this and turning over the fifth sacral vertebra and coccyx, in which manner the operator can better expose the pelvic cavity than by any other osteoplastic operation. In this way I succeeded very easily in finding the lower end of the rectum, and was able to make an anal opening at the right spot. Unfortunately, the child, which was weak, died of a peritonitis which followed a puncture previously made with a trocar, and the peritonitis had nothing to do with the sacral operation.

"In the second case I again tried the osteoplastic operation,

because in the position of the rectum at the lowest pole of the axis of the body a parenchymatous organ was discovered, which was found, on closer examination, to be a kidney. Unfortunately, even through the sacral opening I was unable to find the rectum, since the entire small pelvis was filled up by the kidney, which, as it turned out later, was *the only one* in the body. There then remained nothing else for me to do but to sew up the sacral wound and to do a colostomia iliaca. The child stood the operation very well, lived four weeks, and the wound was completely healed, but it died of a diarrhœa." ("Ueber Sacrale Operationen," *Verhandlungen der Deutschen Gesselschaft für Chirurgie*, Berlin, 1893, p. 36, 22d Congress.

Case IX. was reported January 14, 1894, by Prof. Fochier, of Lyons. The following is an abstract of Commandeur's report of the case (*Mercredi Medical*, Paris, 1894, pp. 605-607): "Male, weight 2 kilos 500 grammes; two days old. No outward deformity; tympanites. Incision from anus to coccyx, followed by resection of this bone. No pouch could be discovered in the wound. Then the lower third of the sacrum was removed. Nothing was then seen or felt but a layer of dense connective tissue. The perineal route was then abandoned and an artificial anus made in the groin. The operative result was good, but green diarrhœa set in, and the little one died on the fourteenth day after the operation. The autopsy, held thirty-four hours after death, revealed: Healthy peritoneum; firm adhesions around artificial anus in groin. A director introduced through the anus into the colon and downward led to a cul-de-sac, which reached the lower third of the sacrum, *where it could have been easily exposed by the perineal wound had the dissection been pushed a little further* through the subperitoneal connective tissue in front of the sacrum. The rectal pouch was almost entirely invested by the peritoneum and formed a meso like the cæcum. The anal cul-de-sac was entirely separated from the rectum, and there was no trace of the classical fibrous cord between them."

This very instructive experience convinced Fochier of the advantages of early intrapelvic exploration through the peri-

toneum after the failure of subperitoneal dissection to discover the rectal pouch. Had he opened the peritoneal cul-de-sac he would have easily found the rectal ampulla, and the inguinal colotomy would not have been required. Commandeur, who voices his opinions, then formulates a mode of attack through the perineo-sacral region, which is essentially like that proposed by Robson, in 1880, though Commandeur is evidently unacquainted with Robson's paper.

Case X. occurred in my own practice, and has been reported in detail in the *New Orleans Medical and Surgical Journal* for July, 1897, under the title, "Congenitally Imperforate Rectum with a Well-formed Anus, in an Infant at Term; Restoration of the Anal Outlet (Proctoplasty) after Kraske's Operation; Convalescence Complicated by Whooping-cough and Procidentia of the Rectum, Necessitating Excision; Recovery, with Partial Control of the Bowel."

"On August 28, 1894, I delivered Mrs. H. W. of a full-grown male infant. The anus was well formed and the genitals presented no abnormality on inspection. Imperforation of the rectum was discovered the day after birth. A probe could be made to enter the anus a distance of three-quarters of an inch from the anal margin, and no further. The little finger introduced into the anus encountered a complete membranous barrier, and confirmed the existence of an imperforate anal cul-de-sac. At 11 P.M., forty hours after birth and without anæsthetics, the operation for the relief of the obstruction was begun. After careful antiseptic preparation the infant was placed on the back with the nates raised high, the thighs flexed and projecting beyond the edge of a hard pillow in an exaggerated lithotomy position. Sufficient illumination was obtained by several lamps. An attempt was first made to determine the distance of the rectal pouch by introducing a long needle attached to an aspirating syringe, in the direction of the hollow of the sacrum and upward. This was introduced a distance of over two inches by penetrating the anal cul-de-sac, which was not tense or bulged when the child cried. In view of negative results a formal perineal dissection was begun. A grooved

director was introduced into the anus as far as it could go without perforating the cul-de-sac, and an incision was made in the median line through the posterior anal margin to the coccyx. As nothing appeared in the wound at this stage of the operation which could suggest the appearance of the rectal pouch, the incision was carried higher up to the base of the coccyx, which was cartilaginous and was easily excised by enucleation without much disturbance to the soft parts. The removal of the coccyx left an opening which readily admitted the little finger for its whole length into the pelvis, and greatly facilitated exploration. The lips of the wound and nates were now fully retracted and careful search made for the missing rectal pouch by dissecting the loose recto-perineal connective tissue. After this a dark-brownish mass was indistinctly recognized as an occluded rectal pouch. An attempt was now made to seize the mass with hæmostatic forceps and to drag it down to the edge of the coccygeo-perineal wound. As this opening was insufficient, and it was evident that any forcible attempt at traction upon the mesenteron would end in a premature rupture of the gut and an inability to form a proper artificial anus, I decided to remove as much of the sacrum as would be required to permit of more direct exposure of the pelvic contents, and also allow of more easy introduction of the finger or instruments into the pelvic cavity, with the view of clearing the rectal end of its attachments, thus permitting me to drag it down to a safe anchorage at the sacral outlet.

To resect the sacrum was a very simple procedure, as the bone was still cartilaginous and could be cut through with strong blunt-pointed scissors with less difficulty than would be experienced in cutting through heavy cardboard. With a few clips of the scissors a considerable fragment of the sacrum was removed up to a point corresponding to the highest level of the fourth sacral vertebra. The sacral excision was central at the coccygeal line, but marginal and to the left as it advanced upward. A fenestrum was thus made in the posterior wall of the pelvis which permitted an easy exposure of the missing bowel and peritoneum. By gently insinuating the index-finger between

the anterior surface of the sacrum and the tissues in front of it, the rectal pouch was sufficiently mobilized to permit it to appear at the sacro-coccygeal opening without dangerous traction. The peritoneum almost completely surrounded the gut, which presented a distended sausage-like appearance, of a dark bluish color. The peritoneal covering was particularly adherent at the lower end of the pouch, and here the serosa was unavoidably torn by manipulations. The rent in the peritoneum was, however, easily closed by a few catgut stitches before the small intestines had opportunity to prolapse through the opening. It was now recognized that the gap between the anus and the rectum was considerable, and there was no sign of the distinct fibrous cord which, according to some observers, sometimes connects the obliterated rectal and anal ends.

The dilated anal extremity of the mesenteron was now gently pulled down until it projected beyond the edges of the wound, and, after securing it at opposite points with artery forceps, was freely opened with scissors in the intervening portion. A flood of meconium immediately covered the field and continued to flow for sometime afterward. In the meantime the parts were constantly irrigated with a douche of warm and weakly carbolized water.

In consequence of the evacuation of the bowel the tension of the rectal pouch was entirely relieved, so that, without traction, the bowel could be brought down to the quite low level of the perineal wound in easy apposition with the natural anus. The rectal ampulla was then sutured to the proctodeal cul-de-sac. The skin over the sacral region was then closed with a few silk sutures. The mode of suturing the anus to the rectum was peculiar; I found it difficult to suture the very much dilated rectal ampulla to the upper segment of the anal infundibulum, owing to the disproportion between the two. I therefore sutured the two ends together in the manner indicated in Fig. 2.

I have since concluded that in a similar case I would prefer to *excise* the mucosa which lines the anal cul-de-sac completely to the margin of the anus. I would then suture the edge of the rectal ampulla to the margin of the anus, being especially care-

ful not to injure the submucous tissues with the sphinteric fibres. The objection to leaving the original anus *in situ* is mainly that the interposition of the mucous membrane of the ampulla in its posterior segment is bound to act as a wedge of foreign tissue which may interfere more or less permanently with the efficient contraction of the sphincter.

After the operation the child was washed and soothed by a general immersion in a tub of warm water, after which the parts were dusted with iodoform powder and covered with gauze.

Notwithstanding the extent of the operation the baby's condition was excellent. It kept up a continuous cry at first, but it subsequently intermitted with the less painful manipulations and procedures; after the final bath and dressing it went to sleep very quietly, as if nothing had happened. There was no loss of blood of any consequence, no vessels were ligated, and the precautions taken to keep the baby warm assisted in diminishing shock. On the fourth day marked signs of whooping-cough, which was epidemic in the neighborhood, became manifest, and for some time threatened the final success of the operation. In spite of this condition the healing of the wound progressed rapidly and favorably. The bowels moved regularly, and there was scarcely any irritation in the neighborhood of the wounded surface.

The frequent paroxysms of pertussis appear, however, to have precipitated another complication which soon compelled another operation. In consequence of the enlargement of the pelvic outlet by the coccygeo-sacral resection and the laxity of the anal orifice from weak sphincter control, the rectum began to yield, and not many days elapsed after the violent cough had set in, before three inches of prolapsed rectum protruded from the anus. All attempts to control the escape of the bowel failed. Consequently on September 20th, twenty-eight days after the first operation, I amputated three inches of protruding rectum by a simple and efficient method which resembles Kleberg's procedure, and which I have described in detail in the report of the case in the *New Orleans Medical and Surgical Journal*, July, 1897.

After finishing this operation I found it necessary to circumcise the child on account of phimosis, which made urination painful. These operations were followed by no unpleasant consequences, and in ten days the child was entirely well with the exception of an incipient inguinal hernia, which became less troublesome as the cough diminished. It is also worthy of note that in addition to the anal defects, the phimosis, and the disposition to hernia, the child was born a unilateral criptorchid, one testicle having failed to reach the scrotum.

After this event the child continued to grow and to do well, though he was more fretful and less vigorous than his other little brothers. Last summer, or about one year and a half after the operation, the baby was brought to the city, and I had an opportunity of examining it.

The child has normally three or four bowel movements a day. It is difficult to ascertain if there is complete bowel control, but the finger feels a decided resistance and contraction when it is introduced a short distance beyond the anal margin. When there is diarrhœa, which is not a rare occurrence, the control of the bowel is almost lost. There is also a slight tendency to a recurrence of prolapse, though in much less degree than when this condition first existed.

While the child has thus far survived, and is apparently in fair condition, it is evident that it has had to travel over a very rough road.

The instructive features to be especially noted in this case are: 1st. That without the increased space gained by Kraske's operation I would have been compelled to perform colotomy. 2d. That the resection of the coccyx and the sacrum permitted not only an easy exploration of the pelvis and recognition of the distended ampulla, but that it allowed the bowels to be sutured to the anus after the meconium had been evacuated. 3d. That the advantages obtained by the sacral dissection during the operation have been in part offset by the weakening of the pelvic floor caused thereby. 4th. That this could be obviated in future by applying simple median sacro-coccygotomy, with or without osteoplastic flaps, instead of the typical Kraske resec-

tion. 5th. That notwithstanding its weakening effects on the pelvic floor the Kraske operation in this case is far more satisfactory in its results than an inguinal colotomy.

Case XI. is reported under the heading, "Successful Laparotomy, and Kraske's Operation on an Infant, Two Days Old, for Imperforate Rectum," by Dr. J. W. Elliot, of Boston. (*Medical News*, New York, October 17, 1896). It is so instructive and interesting that I reproduce it almost textually: "May 1, 1896, an infant (female), aged two days, was brought to the Massachusetts General Hospital with the history that it had passed no meconium since birth. Weight, six pounds ten ounces at birth. Perfectly formed anus, in normal situation, terminating in blind pouch less than one-fourth of an inch deep. The little finger, passed into the vagina, failed to reveal distended bowel.

"*Operation.* Incision from anus to above the level of the top of the sacrum. After a few minutes' dissection it became evident that the lower rectum was entirely absent. The posterior wall of the vagina bulged into the wound, and was opened in order to inspect its upper end. Coccyx then removed with scissors, but no portion of the rectum could be found. The lower part of the sacrum was next cut out on the left side, up to about the third foramen, making a regular Kraske operation. The finger was then pushed in just in front of the sacrum to a considerable depth, but the bowel could not be felt. The child was then turned on its back in the Tredelenburg position, and the abdomen opened in the median line. The urachus and the bladder were met lying against the abdominal wall, and were avoided. The lower bowel was found to consist of a greatly distended pouch, which filled the abdomen and seemed to spread out over the whole pelvis, but not enter it. Its distended condition prevented its being pushed into the pelvis. A trocar was passed in through the sacral wound, and, with two fingers in the abdomen to guide it, was pushed into the distended bowel. Gas escaped freely, and as soon as the bowel had collapsed it was pushed down in front of the sacrum until it was caught in the sacral wound, where it was opened

and stitched to the skin, as in a regular Kraske operation. The abdominal and perineal wounds were quickly closed with sutures.

"The infant bore the operation remarkably well. Great care was taken to keep it warm. It was fed on modified milk (Rotch's formula). In five days temperature became normal. Gas and feces passed freely through artificial anus. The child gained nearly two pounds in three weeks, and was discharged from the hospital on the twenty-seventh day in good condition.

"The child was in excellent health three months after the operation."

Case XII. is incidentally referred to by Professor W. W. Keen, in an admirable article on the treatment of rectal cancer, etc., in the *Therapeutic Gazette*, May, 1897. Professor Keen has kindly favored me with the notes of this hitherto unpublished case, which I am much pleased to report in detail, as it illustrates several unusual features. The child was born December 27, at 11 A.M., and the operation performed December 29th, at 4 P.M., fifty-three hours after birth.

"Congenital imperforate rectum and retention of urine from unknown cause; Kraske's operation. Death after eighteen days from malnutrition. T. P. C., aged fifty-three hours A very feeble infant. The child had neither defecated nor urinated since birth. On examination the anus appeared normal in every respect, but the anal portion of the bowel was found to be only about one-third of an inch in depth. On examination of the bladder, it was impossible to determine how full it was, as the belly was so much distended. The tympanitic sound went nearly to the pubes. On attempting to introduce an instrument into the bladder, this was apparently arrested at the membranous or prostatic portion of the urethra.

"I did an ordinary Kraske operation, removing the coccyx and three-fourths of an inch of the sacrum, which was, of course, readily divided transversely by a pair of ordinary scissors. I next perforated the upper end of the anal portion of the rectum, and dilated it with a pair of hæmostatic forceps. I then passed two long silk sutures, one in the anterior and one

in the posterior part of the blind pouch of the rectum, and the ends were drawn out through the anus. I opened the lower end of the cul-de-sac of the rectum, and then immediately drew the open end through the anus by means of the two silk sutures and attached it to the perineum. The wound was then carefully cleaned, as it had been slightly filled with meconium. The sacral wound, excepting where a small drain of iodoform gauze was placed, was then closed. Only a little meconium, and no gas, was discharged through the bowel; but in order to determine its patency I introduced a pair of hæmostatic forceps, which passed in readily up to the handle. I next did a suprapubic cystotomy. I did not even see the peritoneum; the bladder was immediately recognized by its making a hernia into the wound as soon as the bladder-wall was reached. This was opened, and not over two or three drachms of urine escaped. An instrument could then be introduced into the bladder through the urethra. What the nature of the obstruction was, and why the child was unable to urinate, I am quite at a loss to determine.

"The temperature, after the operation, rose to 100.2°, but fell to normal in two days. The child died eighteen days later from malnutrition.

"The secretion of urine was fully established, but the suprapubic wound was not healed at the time of death, and, therefore, the urine never passed through the urethra."

After this contribution was written the details of the following interesting case, which occurred in this city, were communicated to me by the operator, Dr. Ernest A. White. This would make the total cases of Kraske's operation that I have been able to collect, thirteen. For want of time I have not been able to modify my conclusions in accordance with this case. The case is properly one of atresia ano-vesicalis. The anus was totally absent, and the colon emptied directly into the bladder.

Dr. White describes the case as follows: "When called to see this child (M. S., born December 28, 1895, 1 P.M.), four days after birth, I found it in great pain, and the abdomen distended. The parents acquainted me with the fact that the

child had had no passage, and that there was no anal opening. I closely examined the baby and found the anus missing, there being only a darkened spot where the anus should have been. I was also told that the child had passed fecal matter with the urine. This, then, cleared up the nature of the case. I at once suggested an operation, which I performed on the same day, January 1, 1896, at 2.30 P.M. I first tried to reach the gut through a perineal incision, which was carried up for some distance into the floor of the pelvis. As no sign of the rectum could be discovered, I removed the coccyx and a portion of the sacrum. Even with this large opening I failed to find the ampulla. The peritoneum was opened, and some coils of small intestine presented themselves, but they were at once replaced and the peritoneum was sutured. I then concluded to perform laparo-colotomy, closed the incision made posteriorly with sutures, and made an oblique incision in the abdomen a little more than midway between a point two inches below the umbilicus and the anterior-superior spine of the ilium. When the peritoneum was opened the bladder, which was much distended, at once protruded through the incision. By passing my finger into the cavity I could easily feel the colon, as it terminated directly into the bladder. By an unfortunate accident the thin walls of the bladder were punctured with the point of a grooved director, and a jet of urine stained with meconium and gases escaped into the wound, some of it, no doubt, entering the peritoneum. I passed my finger around the colon, and placed a silk ligature around its vesical extremity and a band of sterilized gauze around the bowel end, with the view of excluding the colon from further communication with the bladder. The tubular isthmus was then cut across with scissors. The vesical end of the colon was then carefully washed and closed, and allowed to drop back into the cavity, and the terminal end of the colon, still held in the gauze band, was brought to the level of the skin, where the mucosa was sutured with silk, so as to form an artificial anus. The child appeared to be relieved by the free discharge of meconium that followed, and was easy for three hours after the operation. Nevertheless, the peritonitis

that had existed before the operation continued unabated, and the child died at 1.30 A.M., January 2, 1896, or eleven hours after the operation."

This was an exceedingly unpromising case from the start, owing to the existence of peritoneal infection before the operation. It is possible, had the condition of the infant permitted, that by previously evacuating the bladder, the communication existing between this organ and the colon could have been recognized and severed by the sacral route. The condition of the patient was so serious, however, that the operator preferred not to delay in reaching the colon by the upper route. In dealing with a similar case I would adopt the method of inverting the stump of the colon into the bladder, just as in Dawbarn's method the stump of the shortened appendix (in appendectomy) is inverted into the cæcum.*

* While this article is going through the press an additional case of Kraske's operation (Table II., No. 14) for ano-rectal imperforation has come to my notice. It is reported by Prof. W. J. Brault, of the École de Médecine, of Algeria, Africa, in the Gazette des Hôpitaux, Paris, August 10, 1897, No. 90. The infant, a female, aged two days, was brought to Dr. Brault for treatment, February 3, 1897. It was in a very exhausted, almost moribund condition. An attempt to reach the gut was made by perineal incision from the anal infundibulum to the coccyx and beyond. Nothing to indicate the presence of the rectal ampulla was discovered in the depth of the wound, and, as the condition of the child did not justify further extension of operation into the sacral region, a left iliac colostomy was performed, from which the child promptly recovered. The opening into the colon was made in a manner to give issue to the meconium without forming an eperon, purposely to favor the final restoration of the anal outlet in the future.

At the end of three weeks, when the child had recovered from the colostomy, Brault, yielding against his judgment, to the constant entreaties of the parents, performed a Kraske resection, with a view of restoring the normal outlet. This operation was performed February 23d. A long incision from the anal orifice, which was well formed, to the lower third of the sacrum, exposed the anal infundibulum, the posterior vaginal wall, the uterus and the terminus of the rectum, which ended as a flat tapering band in a manner resembling the mouthpiece of a whistle or clarionet (*bec à sifflet*). The extreme terminus of the gut was recognized by introducing a Benique sound as a guide through the opening of the iliac anus. By keeping this guide in the gut the bowel was dissected away from its attachments in the pelvis and sutured to the deep layers of the sacral wound. The blind end of the gut terminated near the middle of the sacrum, and owing to its high termination and flattened tip, it was a difficult matter to bring it down to the level of the wound. Nevertheless, the functional result was good. The feces escaped freely through the new anus, and the iliac opening became inactive and was becoming rapidly obliterated, when, on the ninth day after the second operation,

XV.

Synopsis of the Results Obtained by Sacro-coccygeal Resection by Kraske's Method, or its Modifications, for Imperforation, and the Conclusions that May be Deducted Therefrom.

A. Simple Coccygectomies. After careful examination of the literature of the subject, and a personal perusal of the references given in the *Index Catalogue* and *Index Medicus* to the present date, I find that since 1842, when Amussat performed his first operation, the coccyx has been attacked for imperforation sixteen times. These are tabulated elsewhere. (Table I.) Of these sixteen cases, ten recovered from the operation and six died. The causes of death are summarized as follows:

In Case I. (Amussat's) a vesico-rectal fistula existed; lumbar colotomy (Amussat's method) was performed after a failure of the perineal incision and coccygectomy to expose the enteron. Autopsy proved that if pelvic exploration had been continued the ampulla could have been reached and opened in perineo. Death within twenty-four hours, from exhaustion.

Case III. (Verneuil's). Extreme exhaustion; premature birth. Operation three days after birth. Death in forty-eight hours.

Case IV. (Verneuil's). Premature birth. Death on the tenth day. Jaundice and athrepsia.

Case VII. (Tarnier's). Congenital œsophageal stricture. Death in thirty-six hours.

Case IX. (Polaillon's). Death within twenty-four hours.

signs of progressive malnutrition began to manifest themselves and continued until the eleventh day, when the infant died in complete athrepsia.

Brault states that had the child survived the sacral operation he would have attempted to transplant the original anal infundibulum with its sphincter apparatus in a sliding flap to the new sacral orifice, hoping in this manner to secure a complete fecal control of the sacral outlet. This is certainly an ingenious suggestion, but it is questionable whether the transplanted sphincters could be made serviceable after severing their nervous connections.

Atresia of œsophagus and numerous other serious malformations.

Case XIII. (Anders'). Death within twenty-four hours after operation. Operation on fifth day, after peritonitis had set in.

If we exclude Case IV. (Verneuil's), which died on the tenth day, from jaundice and marasmus, then the operative mortality could be reduced to five out of sixteen cases, or 31.20 per cent.

If we again exclude the two cases in which stricture of the œsophagus coincided with rectal malformation, reported by Tarnier and Polaillon (Cases VIII. and IX.), and Anders' case, which was operated on the fifth day in an almost moribund state, after peritonitis had set in, then the total number of cases in which death was apparently connected with the operation would be reduced to two out of sixteen cases, or 12.50 per cent. mortality. If we take into consideration the bad general condition of the infants upon whom these operations were performed, it is very probable the operation itself did not contribute to the mortality as much as even these results would show, for we find that in the modern series of sacrectomies that follow, in which much more serious and extensive procedures were applied, the immediate operative mortality is only one out of twelve, or 8 per cent.

A further examination of Table I. shows that in two out of the sixteen cases the ampulla could not be found, in spite of coccygectomy; and lumbar colotomy in one, and Littré's operation in the other, had to be performed, though in one (Amussat's) case the colotomy would not have been necessary had the perineal exploration been carried further.

In two out of the sixteen cases (Amussat's and Verneuil's) entero-vesical fistula complicated the imperforation. In one case (Duret's) urethro-vesical fistula existed.

In two cases, as stated previously, œsophageal stricture and other malformations coincided; in all, five cases in which very grave congenital malformations existed with the anal imperforation, or 31.25 per cent., were badly complicated cases. In thirteen cases the period intervening from birth to operation is

specified, and this varies from a few hours to five days. With the exception of Byrd's case (Case XI.), which was operated on the fourth day with success, all the patients that recovered were operated within a period of three days. A detailed study of these cases, as well as of all others, confirms the opinion that the earlier the operation the greater the endurance of the infant and the better the chances of recovery.

B. Sacro-coccygectomies: Statistical and operative considerations. Twelve cases* have been reported, and are summarized in Table II. Of the twelve cases reported only two succumbed to causes directly connected with the operative treatment, and in one of these death was caused by peritonitis due to infection of the peritoneum—*i. e.*, after an exploration with a needle previous to the sacral operation (Czerny's Case II.).

Eight out of the twelve cases died at variable periods, from a few days to two months after the operation, from diarrhœa, marasmus, capillary bronchitis and other conditions not directly connected with the operation.

Four out of the twelve cases had survived up to the time when they were reported. In Burrell's case, four and a half years after the operation; in Poisson's, three years; in the author's case, two years and nine months; in Elliot's case, six months after the operation.

In seven out of the twelve cases the time intervening from birth to operation is specified, and this varies from twenty-four hours to four days; Burrell's case, which is one of the most successful, was operated on the fourth day. In five cases out of the twelve (Vincent's, Fochier's, Czerny's, Chaput's, Elliot's) the sacro-coccygeal operation failed to reach the enteron. In two only (Vincent's and Czerny's) the failure was complete, and the supplementary colotomy was permanent. In two (Chaput's and Elliot's), a supplementary laparotomy with enterotomy, performed at the same sitting, allowed the enteron to be drawn to the perineo-sacral wound and restored the lower pelvic anus. In one (Fochier's) the autopsy proved that had the pelvic explora-

* White's and Brault's case were added to Table II. after this summary had been written.

tion been continued, the enteron would have been found in the pelvis, and that the colotomy was superfluous. It is thus shown that only in four out of twelve cases the sacro-coccygeal operation was insufficient, and that in eight cases (66.6 per cent.) simple perineal incision alone would have failed to discover the ampulla; but the application of Kraske's suggestion was effectual in establishing a perineal anus, though in two out of the twelve cases a supplementary abdominal incision was required to bring down the gut to the perineum or perineo-sacral region.

From the purely technical point of view the sacro-coccygeal route, whether applied with actual excision of bone, on the original Kraske plan, or by simple osteoplastic flap, or by a parasacral incision, does not appear to offer any special difficulties in the newborn infant. In twelve cases tabulated in Table II. the following procedures were adopted by the different operators in dealing with the sacrum. Eight operators excised variable portions of the sacrum, the scissors being almost invariably used. One operator successfully applied Bardenheuer's operation (Ceci). One operator, Czerny, resorted to osteoplastic flaps on the Rhen-Rydygier plan. One operator, Vincent, made a parasacral incision up to the sacro-sciatic notch, and in another case split the coccyx and sacrum in two halves by median incision. All these operators refer to the ease with which the coccyx and the sacrum can be incised or excised, owing to its cartilaginous condition. None appear to have been annoyed by excessive or dangerous hemorrhage. Several refer to the rudimentary conditions of these parts as being highly favorable to the operation in question, and speak of the benefits to be derived from the sacral route as a means of exploration and of conveniently reaching and evacuating a highly placed enteron. Thus far no accidents or evil consequences are reported from opening the vertebral canal, though in no case have total resections above the third sacral foramen been distinctly mentioned.

XVI.

The Choice of the Sacral Operations.

It will be observed that from the especially favorable conditions presented by the newborn infant, almost any of the modifications of the original Kraske operations are applicable to this class of cases. It will be well to consider, however, which one of the numerous variations of the original Kraske procedure will prove the most advantagous for the present purpose, which, as previously stated, is not to extirpate extensively adherent and infiltrated growths, but is merely utilized, primarily, to diagnosticate the position of the terminal end of the rectum, and, secondarily, to create an opening in the sacro-coccygeal space which will be large enough to permit of easy manipulation and fixation of the gut to the lowest level of the sacral or perineal surface.

The various operations performed by the sacral route have been classified into three groups (Chaput).[82] 1. Definitive sacral resections. 2. Temporary sacral resections. 3. Parasacral incisions; but he has omitted the fourth and most important, the median sacral incisions.

The parent type of all the definitive resections is Kraske's operation, which is described as follows: A median incision is made, commencing about the middle of the sacrum and ending behind the anus. In infants, when the operation is performed for imperforation, the excision is begun at the anus and is carried up to the middle of the sacrum. As usually performed in the adult, the back of the sacrum and coccyx are exposed, the tissues are separated from them on their left border. The coccyx is disarticulated, and a portion of the left side of the sacrum is removed. The line of bone section takes a curved course, beginning below the third sacral foramen, arching inside the fourth, and terminating at the lower border of the fifth sacral vertebra. In fact, the incision into the bone should begin with the coccyx, and, gradually ascending upward, would attack the lateral border of the sacrum up to the third sacral foramen, or until such space

has been obtained that will permit of easy exploration of the pelvic contents. The remaining steps which, in the adult, consist in the isolation of the rectum, the extirpation of the cancerous neoplasm or diseased portion of the gut, for which this operation was especially created, do not concern us here. Neither are we interested, in this contribution, in the various methods recommended for suturing the divided ends of the bowel after excision. These are most important and essential details in the surgery of rectal disease in the adult, but in the study of imperforation we are chiefly concerned in the best means of obtaining a *free*, *easy*, and *safe* entrance into the pelvis of the newborn infant. As in the majority of cases the enteron will be found and will be easily brought to the perineum, it is scarcely necessary to permanently sacrifice any part of the sacral wall of the pelvis. Furthermore, the removal of an extensive portion of the osseous framework at this point weakens the pelvic floor and favors a procidentia of the rectum. This may occur after simple coccygectomy (Delens' case), and has occurred twice in the twelve cases of sacral operations that I have tabulated. (Poisson's and the author's cases.)

Hence it follows that in adopting the sacro-perineal route for purely exploratory purposes it is well to select the simplest and most economical operation, viz., that at least which permits of an easy exploration of the pelvis and a closure of the wound without permanent mutilation. Fortunately, *all this can be readily accomplished by a simple median sacro-coccygeal incision* (*median sacro-coccygectomy*), with unilateral or bilateral transverse incision, which will form unilateral or bilateral osteoplastic flaps; or, again, the pelvis may be entered by an original parasacral incision, which can be combined with a transverse sacral incision, thus forming a triangular osteoplastic flap of the required size. Either one of these general methods is easily applied to the cartilaginous structure of the newborn infant, owing to the ease with which the parts can be retracted.

XVII.

Vincent's Parasacral Incision.

Median sacro-coccygotomy was first successfully applied by Vincent, of Lyons, in 1887. (See Table II., Case 2.) By this incision he obtained free access to the rectal pouch. Vincent, however, favors a parasacral incision which he had also successfully applied in imperforation (Case 1, Table II.). Vincent's parasacral incision, which he prefers, is identical with that subsequently described by E. Zuckerkandl[83] and by Wölfler[84], as applied to the rectal surgery of the adult, though the parasacral incision has not met with much favor in adult surgery because of its alleged insufficiency. (See No. 1, p. 518.) Vincent has proved that a parasacral incision is feasible and may yield satisfactory results in dealing with imperforation. Vincent begins his incision in the perineum, at the anus, if this exists, and carries it vertically backward to the tip of the coccyx, and from this point closely follows the contour of the left border of the bone up to the highest level of the sacro-sciatic notch. By careful dissection, the incision is prolonged into the depths of the pelvis, and the vessels and nerves are avoided; the recto-peritoneal space is reached, and is exposed up to the highest level attainable. If, after thorough retraction of the edges of the wound, the space is not sufficiently wide, the edges of the exposed sacrum can be bitten off with the rongeur until the gap is wide enough to allow free exploration with the finger. By the simple parasacral incision, Vincent and Maitre, his pupil, contend that the rectum can be reached when it is at a distance of three or four centimetres above the level of the perineum. As the promontory of the sacrum and the upper pelvic strait is, at furthest, only 5 centimetres from the anal point, and more often only 3 centimetres in the deformed pelvis of the imperforate fœtus, it is easy to understand that the enteron can be reached and brought down to the level of the wound by this incision, if it lies almost anywhere in the pelvis. Vincent practically demonstrated this when he was able to explore the iliac fossa and bring down the rectal pouch from this

point to the sacrum in one of his patients on whom he applied the parasacral method.

It can be readily conceived that should the simple parasacral incision prove insufficient it would be a simple matter to make a horizontal section at any desired level (not higher than the third sacral foramen, however), and thus to transform a parasacral incision into a triangular flap on the plan suggested, with slight variations, by Heinecke[85] (1889), Roux[86] (1889), Billroth[87] (1889), Rhen[88] (1890), Rydygier[89] (1894), etc. (See No. 2, p. 518.)

As no saw, chisel, or rongeur is required for dividing the sacrum on a level with the third foramen in an infant, no difficulty need be apprehended in effecting the rapid transformation of a parasacral incision into a complete osteoplastic triangular flap. This flap can be turned to the right or left, according to whether the primary parasacral incision is carried to the right or left of the sacral border. The left border of the bone is preferred by Vincent and others, because it is supposed that the rectum is more likely to be found in the left of the pelvis; but this is not materially important, as the rectum is extremely variable in its relations to the median line, and is more likely to occupy the middle line of the sacrum as it approaches the pelvic outlet.

XVIII.

The Median Operation.

Notwithstanding the simplicity of Vincent's parasacral incision or the modifications to which it might be subjected, I believe, as previously stated, that as a preliminary exploratory procedure, a simple median incision through the coccyx and sacrum (median sacro-coccygotomy) is a preferable operation. The advantages that may be claimed for the median sacro-coccygotomy are: first, that it greatly diminishes the risk of injuring the levators and the coccygeus, and thus causes the least disturbance or the least weakening of the pelvic floor; secondly, that it is less likely to injure the third and fourth sacral pair of

nerves which supply the sphincters, levators, and bladder; third, a median incision is less likely to be followed by serious hemorrhage; fourth, a median incision will not interfere with the lateral blood supply, which is a matter of some consequence in performing osteoplastic operations.

These advantages of the median section have laid the foundation for the median osteoplastic temporary sacrotomies devised by Heinecke[90] (1888), Kocher[91] (1889), Jeannel[92] (1890), Gussenbauer[93] (1893), Borelius[94] (1894), and by Morestin[95] (1894), who have modified the median or oblique section of the sacrum by the addition of one or two transverse cross-sections on a level with the highest point of vertical division. The ultimate result of these procedures is that the sacrum and coccyx are divided vertically with the skin and other soft parts, and transverse sections are made, leaving an incision like a T, which forms two osteo-tegumentary flaps, which can be replaced and sutured after the operation on the rectum is completed.

As these methods have been especially devised to meet the conditions found in rectal cancer in the adult, I will not stop to discuss them individually, but will simply refer the reader to the admirable and recent contributions of Kammerer,[96] Gerster,[97] Morestin,[98] Taylor,[99] and Sieur,[100] wherein the most recent and numerous methods of effecting an entrance into the pelvis by the sacral route are fully and critically reviewed. I will now simply limit myself to a brief description of median sacral coccygotomy, as suggested by Sieur for the treatment of ano-rectal imperforation, which I would supplement by a transverse T section, if required, to make osteoplastic flaps. This procedure is a simple adaptation of Morestin's operation to infantile practice, which, I believe, without any clinical evidence in support of it, except one of Vincent's cases, to be the safest, simplest, and best operation for this particular purpose.

Topographical Considerations. With the inexperienced it is a matter of some difficulty to define by surface markings the safe limits of sacral section. All operators are agreed, as previously stated, on the one point, that *excision of the sacrum should not be carried higher up than the lower border of the third sacral*

foramen. Above this point there is danger from the free opening of the sacral canal and the involvement of the nerve-supply to the bladder, which might be permanently paralyzed; in addition, injuries to the nerves that supply the levators and the sphincters might lead to permanent and irreparable damage to these parts. While in the imperforate infant it is possible that the muscles of the anal outlet and the pelvic floor may be defectively developed, this is no reason why the nerve-supply to the muscles of the pelvic floor and anus should be disturbed any more than is strictly compatible with the main object in view.

To operate, therefore, as conservatively as possible, the surgeon must endeavor to keep in mind as clear a picture of the sacral skeleton as is possible. He must endeavor to identify the most prominent landmarks of the region, which are: the posterior-superior iliac spines; the posterior-inferior iliac spines, which are closely related to the upper limits of the sacro-sciatic notch; the prominence of the second sacral spine; the cornua of the sacrum; the sacro-coccygeal joint, and, lastly, the tip of the coccyx itself. The posterior-superior iliac spines and the second spinous process of the sacrum can usually be well defined in the newborn infant. This last landmark usually marks the level of the second sacral foramina. The sacro-coccygeal joint can also be readily recognized by moving the tip of the coccyx; but all the other points are ill defined and confused to the touch, and we have little to help us in locating the exact position of the all-important *third* sacral foramina.

In the adult, the localization of this important landmark is a comparatively easy matter. Delbet,[101] who studied the surgical topography of the sacrum in its relation with Kraske's operation, arrived at the conclusion that the simplest way of defining the limit of sacral excision was to do so by actual measurement from the tip of the coccyx to the lower border of the third sacral foramen, as determined by an average measurement in several dissections. He thus came to the conclusion that from the tip of the coccyx to the lower border of the third sacral foramen, in the average adult subject, the distance is 6 cms.

when measured with a compass. This distance is not to be measured with a tape by following the contour of the bone dorsad, but by previously measuring 6 cms. with the points of the compass on a plane surface. If one point of the compass is placed on the tip of the coccyx, the other will touch the lower border of the third sacral foramen. This is a simple and safe rule in the adult, but it must be modified in proportion when applied to the infant. In my dissections of two still-born infants at term I found that the coccyx measured 1½ cm., and that the lower border of the third sacral foramen is situated at a distance of about 1¼ cm. from the sacro-coccygeal joint. I would therefore advise that in the newborn infant the transverse section of the sacrum that is required in making an osteoplastic flap on the Roux or Rhen-Rydygier plan should be limited by a line not higher than 1¼ cm. or 13 mms. above the sacro-coccygeal junction. The same rule applies, of course, in the performance of median sacrotomy with bilateral cross sections. This is usually amply sufficient for all purposes of exploration. In sacrotomy, however, the median section can, no doubt, be carried higher up, even 1 cm., without risk, as the nerves given off from the cauda equina are not disturbed. If the operation has begun as an osteoplastic operation, the lateral or para-sacral incision can be carried to a point higher up than this, or even up to the sacro-sciatic notch. The disastrous experiences of Schede,[102] Czerny,[103] and others prove conclusively that the dangers of carrying the transverse section above the third foramen, as Rose has done systematically, are not an illusion, and that all such extremely high transverse sections must be proscribed.

The Operation of Election. (See No. 3, p. 518.) In cases in which the anus is reduced to a mere vestige, or is missing altogether, the incision can be commenced at the junction of the scrotum and perineum in the male, and the vulvar commissure in the female. The knife must be kept strictly in the median line, and can be carried to the tip of the coccyx, the operator being especially careful to separate the posterior fibres of the levator if these are recognizable, without cutting their coccygeal attach-

ments transversely. If the anus is normally formed, then the incision is begun in the middle of the posterior segment, and is carried up to the tip of the coccyx, with the same care to avoid dividing transversely the posterior fibres of the levator. This preliminary incision will expose the region above the lower pelvic diaphragm sufficiently to reach the rectal ampulla, if this exists in the neighborhood of the pelvic floor, which is the normal condition in many cases. If the ampulla cannot be detected above the plane of the levators by this procedure, the median incision is then carried up vertically to the middle of the sacrum, and the coccyx and sacrum are divided in the median line so as to bisect the coccyx into two complete and even halves. The osteoplastic lips of the wound thus created are then retracted, and the eye and the finger can search for the ampulla at a considerable depth in the pelvis, above the levator level. If this opening is not sufficient, the sacrum is then divided in its middle line up to the third sacral vertebra without making a transverse section. This will greatly increase the space by the ease with which the parts can be made to retract and yield, owing to the elasticity of the cartilaginous condition of the bone in the infant. By following closely the median line, the connective tissue and fascial planes in front of the sacrum are divided in the posterior tendinous interspace between the levators, and the cavity of the pelvis is fully explored. Without further amplification of the incision by transverse sections, the pelvic contents, the rectum, the uterus, the vagina, the ovaries and tubes, and the bladder can be recognized without necessarily opening the pelvic peritoneum. The search for the ampulla can be continued subperitoneally up to the promontory of the sacrum by following closely the hollow of this bone. In the majority of the cases the rectal pouch will be recognized at this stage of the operation, especially if the pelvis is flexed and the lower abdominal region is forcibly pressed backward so as to direct the intestinal mass toward the sacral outlet. If the ampulla should be surrounded by peritoneum, the serosa can be freely incised, so as to facilitate its descent to the sacral wound. If more space is required, a

transverse section in either one or both sides, so as to convert the median section of the sacrum into two osteoplastic flaps which will tend to come together spontaneously, will be advantageous. If any part of the sacrum is still in the way the cartilaginous sacrum in the osteoplastic flaps can be excised with the rongeur or heavy scissors. Before any sacrifice of the skeleton is made, however, it will be the wiser plan to ascertain the exact relations of the ampulla and the possibility of dragging it successfully to the sacral wound by a previous intra-peritoneal exploration. If a well-formed anal orifice exists it must be fully dilated, and the ampulla can be sutured to the margin of the anal mucosa after excising the superfluous portion of the anal cone. If the rectal pouch is rooted at a high level, and the resistance is too great to drag it down to the anal orifice, an effort should be made to suture it (after preliminary tapping and drainage of its contents) to the coccygeal region in the interval between the levators, which can be made to grasp it by a few sutures in front and behind in such a manner that the new anal outlet shall be placed below the plane of the muscular diaphragm formed by these muscles. To accomplish this the coccyx may have to be sacrificed after careful enucleation.

By adopting this median procedure the operation can be performed not only rapidly but safely, because the hemorrhage is comparatively insignificant. The value of preserving the levators, as insisted upon by Sieur and all operators, is obvious, for upon it will rest, in a great measure, the future sphincter control of the new anus.

Position. In connection with the technique of the operation it will not be amiss to refer to the position that is best suited for that procedure. In my own experience an extreme lithotomy position is the most advantageous during the preliminary steps. If the peritoneum must be opened in the perineum it will be safer to turn the child on the abdomen, face downward, with the view of keeping the urine, which may be involuntarily discharged out of the wound. If laparotomy is required,

the Tredelenburg position is the best, as it permits of easier exploration of the pelvis. If there is marked tympanitis, only the lithotomy position is permissible, though the child may be turned on the side (Sims' position) if the sacral operation is required.

Anæsthetic. As to the anæsthesia, I believe it will be safer to resort to no anæsthetic when the patient is operated upon late after birth, when signs of stercoræmia and exhaustion are manifest. The anæsthetic undoubtedly diminishes the chances of success in such cases. In robust infants a few drops of chloroform over an Esmarch inhaler will suffice to maintain a state of insensibility which will be sufficient to diminish suffering and relax the patient. I did not use any anæsthetic in my case, and the patient recovered without shock.

It is evident that when a sacral anus is necessitated by the shortness of the bowel it must be subjected to the technical rules that govern the formation of the perineal anus or proctoplasty. The governing principles in making a sacral anus being: (1) To make it as low down and as near the normal outlet as possible; (2) to carefully unite the mucosa to the skin, otherwise a simple fecal fistula results, with its tendency to sepsis, dermatitis, and stricture; (3) there must always be enough of the enteron or bowel to permit of an exact suture to the skin without tension. If there is a great strain it will be safer to make a well-formed iliac colostomy, with the hope that the gut may ultimately descend into the perineum or sacrum in the future. *Better, far better, a technically perfect iliac anus to an imperfect, contracting and painful anus in the sacrum.*

To obviate the possibilities of incontinence when the rectal pouch is attached to the sacrum the rectal pouch should be attached below the insertion of the levators, and when this cannot be done it will be well to give the ampulla a rotary twist upon its axis, so as to narrow the lumen of the outlet, as suggested by Gersuny. Notwithstanding what Morestin and others have said in condemnation of this procedure, recent experience (Gersuny, Gerster, Chaput, Thomas, Eiselberg, Rhen, Keen, *et*

al.) has shown that this expedient may lead to good results in competent hands.*

In all cases in which it is possible to drag the rectum without too much traction into the anal orifice, when this exists, it should be done. The enteron can then be invaginated into the proctodeum after resection of the anal cul-de-sac, leaving only the margin of anal mucosa undisturbed. The mucosa of the enteron can then be carefully sutured to the marginal mucous membrane of the anus, with the expectation that an ideal result will follow as far as sphincter control is concerned.

Finally, one of the great advantages that can be claimed for the sacral route in dealing with the anal malformations of the

* Gersuny's procedure is unquestionably the most satisfactory method that has thus far been suggested for the prevention of rectal incontinence after excision. The results obtained by Gerster, Chaput, Thomas, and others sufficiently attest to the practical nature of this suggestion. The great appreciation in which it is held at present is well shown in the recent discussions of the Twenty-sixth Meeting of German Surgeons, held in Berlin, April 24, 1897.

On this occasion Prutz described this procedure as applied in Eiselberg's clinic at Konigsberg. After extirpation of the neoplasm the resected rectum is dragged out of the wound two or three centimetres below the level of the sacral section; it is then twisted upon its axis until the finger which is introduced into the lumen of the gut feels a certain resistance and constriction. The degree of tension usually required varies from 120° to 270°. The edge of the rectum is then sutured to the skin by two tiers of sutures. If the tension is sufficient the flow of mucus and other intestinal secretions that is observed usually after the operation ceases at once.

This procedure was adopted in six cases of extirpation of the rectum, and in two other cases as a secondary procedure. While the control of the feces was not absolutely obtained in all the cases, the result was quite satisfactory, and the speaker did not hesitate to recommend this procedure both as simple and efficient.

Rhen also spoke forcibly of his experience with this method, which he had applied with good results in several cases. He referred to its value when combined with the preservation of the levator fibres, which were utilized to form an additional sphincter in one case.

Gersuny himself laid stress upon a point, that, if omitted, would be likely to lead to a failure of his method. He said that the success of the operation depended, in a great measure, upon the careful suturing of the rectal edge to the skin. If the sutures are not tightly drawn the bowel will untwist, and the effect of the torsion will be lost. In order to prevent the untwisting of the bowel, he suggested that the torsion be made permanent by suturing the folds externally by several external sutures applied to the bowel itself, before the mucosa is sutured to the skin. Of course, care must be taken that the bowel is not strangulated by overtwisting, but the bowel can stand a great deal of tension without any interference with its circulation, and the danger is usually in the other direction, viz., insufficient torsion.

kind here considered is that it permits the operator to cope more readily and directly with the complications that frequently exist, such as vaginal, rectal, or vagino-enteric fistulæ. Also, with recto-vesical and recto-urethral fistulæ. The clinical demonstration of the value of Kraske's procedure in dealing with such conditions is still lacking. But, judging merely by the results of experimental exploration of the pelvis of the still-born infant by various sacral openings, I am confident that many cases in which these complications exist (which would be otherwise inaccessible or could be palliated only by colostomy) will be directly relieved in the future by the sacral operation. This is particularly true of the more serious complications caused by a communication between the bowel and the bladder. Colostomy has been the only remedy for such cases, but this is only in a palliative sense. The aim of the operator should be to separate the connections that exist between the bladder and the intestines. The ease with which access can be obtained into the bladder as well as the rectum and signoid flexure would suggest the feasibility of radically relieving such cases by the sacral route.

To conclude, then, with the sacro-coccygeal route, we will state that it is indicated: (1) As a primary exploratory measure in all cases of imperforation in which a simple perineal incision will not permit of adequate digital exploration of the pelvic cavity up to its brim. For this purpose the median sacro-coccygotomy, parasacral incision of Vincent, or any one of the classical osteoplastic flaps, without primary resection, will be sufficient; (2) in all cases in which intrapelvic exploration through a perineal incision demonstrates the presence of the enteron at an accessible point in the pelvis, but cannot be dragged down. Here the sacral route is applied with a view of reaching the rectal pouch, so as to evacuate it and mobilize it sufficiently to permit its being sutured at the lowest point in the sacro-perineal wound; (3) in all cases of imperforation* in which the enteron communicates by fistulous opening

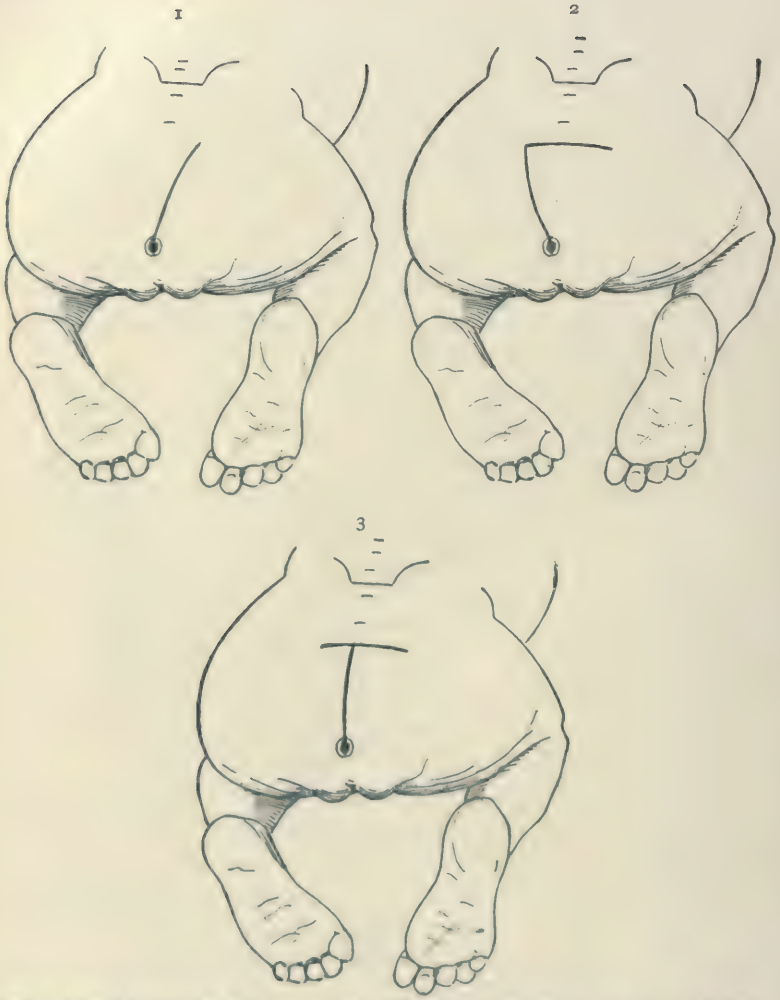
* The application of Kraske's procedure for the cure of recto-vaginal fistula by Kammerer, Hydenreich, and others in the adult, would confirm its great possibilities in this class of cases.

with the vagina, the bladder, or the urethra, the object of the operator being to close the abnormal communication and restore the normal outlet; (4) in all cases in which the enteron has been arrested in its descent above the pelvic brim, but in which a secondary inguinal laparotomy with colostomy permits the operator to drag the enteron into the pelvis or to a convenient point on the sacral surface, where a proctoplasty can be successfully attempted; (5) as a secondary procedure in all cases of primary inguinal colostomy in which the exploration through the colon demonstrates that the rectal cul-de-sac can be guided to the pelvic floor, where an anus nearer the natural outlet can be formed.

Comparative Mortality. Judging from the standpoint of the immediate operative results, Kraske's operation and its derivatives is a simple and benign procedure in the newborn infant, which adds no gravity to the operative treatment of imperforate anus, especially since modern methods of asepsis and hæmostasis have been brought to bear upon this class of cases, Thus, up to 1889, Ducuron's statistics[104] show that the simple perineal methods (without sacrectomy) yielded 61.9 per cent. mortality, and transperitoneal colotomy (Littré) 62.6 per cent. In 1893 the improved technique of the aseptic period enabled Anders (*loc. cit.*) to show that in 100 cases the mortality for simple perineal proctoplasty had been reduced to 29.44 per cent.; perineal incisions and other irregular procedures (trocar punctures, dilatation, etc., on the old plan), 32.22 per cent., while Littré colotomy stood at 52.8 per cent.

If we contrast with these statistics the twelve cases of sacral operations which we have tabulated elsewhere we note that there was only one death attributed to the operation (if we eliminate one of Czerny's cases) or 8 per cent. immediate operative mortality. This is quite remarkable when we consider that in five out of the twelve cases laparotomy was performed in addition to the sacro-coccygeal operation, and that in two a permanent anus was left in the groin.*

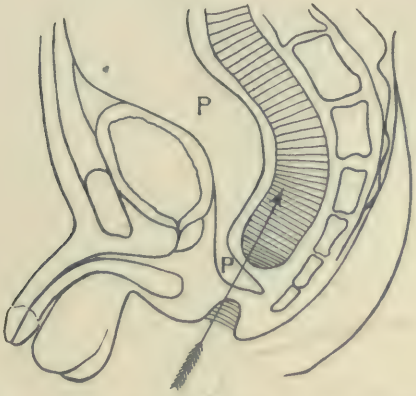
* This estimate is based on the analysis of the first twelve cases: the addition, since, of White and Brault's fatal cases would scarcely affect the immediate operative mortality, though the ultimate mortality is increased to 71.3 per cent.



Three typical incisions in the sacral region which are applicable to cases of congenital ano-sacral imperforation.

1. *Parasacral-type.* (Vincent, Zuckerkandl, Wölfler.) This can be readily transformed by a transverse section into No 2.
2. *Single Solid Osteo-tegumentary Flap* (Billroth, Rhen, Rydygier, Roux). When mobilized, this flap is turned over to the right. It may involve complete transverse section of the cartilaginous sacrum on a level with the third sacral foramen, or it may be utilized for lateral sacrectomy.
3. *Median Coccygeo-sacrotomy* (method of election). Simple median section of coccyx and sacrum may be sufficient, with retraction, for exploratory purposes. One or two lateral osteoplastic flaps may be readily mobilized, if required, by the addition of an upper transverse section on a line with the lower boder of the 3d sacral foramen. The same median incision may be utilized for a typical Kraske sacrectomy, but this is not recommended.

FIG. 1.



Arrow shows how peritoneum can be contaminated by exploratory puncture of rectal cul-de-sac through anus. (After Cripps.)

FIG. 2.

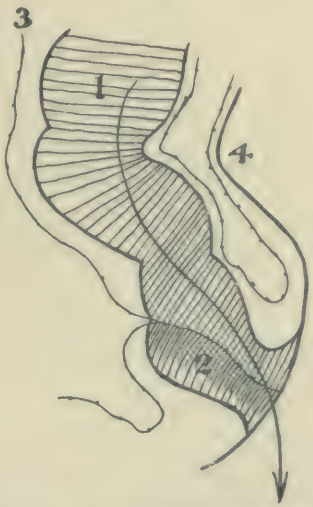


Diagram showing lateral anastomosis of proctodeum and mesenteron in imperforation. 1. Mesenteron or rectum. 2. Anal cul-de-sac or proctodeum sutured together. 3. Peritoneal reflection. 4. Promontory of sacrum.

On the other hand, the general mortality from other non-surgical causes which are so common to defective children (marasmus, diarrhœa, bronchitis, etc.) increased this mortality to 66 per cent., if we embrace in this category all cases that had perished before the date of their publication. In fact, four only out of the above twelve lived and were in good health at the time when they were reported.

We must, therefore, conclude from this that while the prospect of *immediate* operative relief is excellent and most encouraging in these cases, it must be admitted that the final outlook for the survival of imperforate infants is still quite gloomy.

XIX.

The Perineo-sacral Route Combined with Cœliotomy for the Relief of Imperforation.

When, as in very exceptional cases, the enteron cannot be found in the pelvic cavity or in the margin of the iliac fossa, or, again, when the terminal cul-de-sac of the colon is present, but is so firmly attached to the lumbar region that it cannot be dragged down without the risk of tearing it and spilling the meconial contents into the peritoneum, there are five paths open to the surgeon who has already begun his operation by the perineal route. His choice between the methods must then depend largely upon the general condition of the patient when this stage of the operation is reached and upon the anatomical conditions that he may find after performing laparotomy. If the exhaustion is marked and life is ebbing fast, and it is evident that any additional traumatism or shock would be fatal, the wisest course to pursue would be (1) to seize the nearest distended coil of intestine, attach it to the wound, and give issue to its contents. But (2) if the condition of the patient is fair and will justify further operating, a lateral or inguinal laparotomy should be performed with a view of identifying the true terminus of the colon and bringing it down to the perineum; or (3) should the condition of the patient fail at this moment it would be preferable to perform a simple colotomy

to relieve intestinal tension, with the expectation of completing the operation at some future time—*i. e.*, making a perineal anus by guiding the cul-de-sac to the pelvic floor with the help of a director introduced into the colon through the inguinal opening. (4) Should the worst anatomical conditions be recognized, and it be found that the colon terminates too high up in the lumbar region to permit of its immediate or subsequent descent to the perineum, then the *dernier ressort*, a permanent iliac anus, must be performed. (5) Should even the colon be difficult of access (as in truly teratological cases), so as to make a colotomy impossible or very difficult, a simple enterotomy on the Nélaton plan, by attaching the nearest and most distended loop or bowel, would be preferable to making an additional opening in the right iliac region with the view of draining the cæcum. (Pillore's operations.)

The suggestion to bring the first distended coil of intestine that can be felt in the pelvis to the perineal wound, when the exhaustion of the patient is such that no further procedures are permissible, has been applied too often with success in the adult since Nélaton applied it for the relief of intestinal obstruction to require much justification or special pleading under these circumstances. Unfortunately, the formation of a perineal anus by an enterotomy on the Nélaton plan in imperforate children has not been performed often enough to permit us to arrive at any statistical conclusion as to its ultimate value. To my knowledge it has been done but once, and this, even, was not carried out through a perineal wound, but through an inguinal incision. This was Krönlein's case, which was reported in 1879, and is mentioned with other details in the section of this paper dealing with Stromeyer's suggestion. In this case Krönlein explored the pelvis with the finger introduced into the artificial anus seven months after the inguinal enterotomy had been performed, and was fortunate enough to recognize a resisting body in the pelvis, which was supposed to be the missing ampulla. The scar of a previous perineal incision was reopened, and a complete proctoplasty was made, from which the child recovered in three weeks. Here we have conclusive proof of

the value of an artificial anus on the Nélaton plan, by which the operator can, if he is pressed for time by the exhaustion of the patient, disregard the colon and attach the first presenting loop of bowel to the wound, with the expectation of immediate, and probably permanent, relief.

Maylard, in his recent *Treatise on the Surgery of the Alimentary Canal* (1896), deals with this question as follows: "When it is decided to open the bowel, should a colotomy be performed or an artificial anus made?" "From my own experience," he says, "I am disposed to favor the formation of an artificial anus, and for this reason, that the bowel of an infant is so thin, and more particularly so if it has been distended, that it is difficult to accurately stitch it to the parietal wound; and if, as is usually the case, it must be opened at once, the thin meconium is liable to contaminate the surface of the bowel and find its way into the peritoneal cavity. If, on the other hand, a loop of intestine is withdrawn and secured by a rod of some kind passed transversely through the mesentery, and a drainage-tube fixed into the upper end of the loop in such a way that the meconium can only escape through it, there is little or no danger of septic infection. It has also the greater advantage that a much shorter time is required to make an anus than to make a fistula such as results from a colostomy. The only objection which the method has is the difficulty of closing the anus as compared with the fistula, if such be required." In my mind the danger lies in excluding too much active intestine and opening the gut at a point too near the stomach, but the danger of committing a physiological error is not greater in infantile cases of this kind than in the adult, and is perhaps less when the attempt is made by the sacral route than by the higher abdominal incision. The parts of the intestinal tract that are more likely to present themselves at the perineal wound, if I may judge by my experimental operations on the cadaver of a newborn infant, are the sigmoid flexor, the cæcum, or the ilium, so that the presenting bowel in such cases is more than likely to be the right one from a physiological point of view. As a simple life-saving measure, and even as a perma-

nent outlet for the intestinal contents, a perineal enterotomy is justifiable.

It is not likely, however, that such an extreme contingency as is here imagined will occur very often, especially after the value of intra-peritoneal exploration through a perineal opening will have become more generally recognized. By this procedure much valuable time formerly lost in dilatory tactics and subperitoneal dissection will be saved, and the operator will be able to proceed to the formation of a sacral anus or to a cœliotomy by inguinal incision before the patient's resources are exhausted. The dangers of exhaustion will also be reduced to a minimum when the general practitioner learns the lesson that the newborn babe is just as capable of resisting the shock of the most extensive traumatism as the adult, if only the operations are performed early enough to prevent the fatal depression of the nervous centres that invariably follows septic intoxication from protracted intestinal obstruction.

Primary perineal incision with or without coccygectomy or sacrectomy, followed by median or lateral cœliotomy, with a view of recognizing the rectal ampulla and guiding it to the perineal or sacral wound.

It was in 1880 that Neil McLeod (*British Medical Journal*, 1880, xi, p. 657), reported a case of imperforate rectum with a suggestion for a new method of treatment, which was to be the starting point for a new combined perineo-abdominal operation, by which the continuity of the intestinal tract to its normal outlet, the anus, would be re-established. He operated on a female infant, May 26, 1879, that was brought to him for the relief of imperforation. The anus was formed and was half an inch deep. After penetrating into the pelvis one and a half inches by perineal dissection without finding the enteron, the operator abandoned the perineal route and proceeded to perform a Littré colotomy. There was contamination of the peritoneum, with meconium and an unusual amount of bleeding in the abdominal wound. Death took place nine hours after the operation, possibly from exhaustion and sepsis. In commenting

upon this case he spoke of the dangers which attended colotomy as usually performed under such circumstances, that is, when the exhaustion of the patient or the distention of the bowel or other conditions led to the contamination of the peritoneum by an imperfect technique. He also regarded the formation of the iliac anus with horror, even if successful. He says: "I would therefore suggest the following which seems to me likely to lead to more satisfaction. Having performed the ano-perineal operation and failed to find the bowel from below, make an incision in the abdominal walls of convenient length, between the umbilicus and pubis, in the middle line or a little to the left of it. Next introduce the forefinger of the left hand into the abdominal cavity, examine the descending colon and rectum to discover the seat and relations of the upper cul-de-sac. Then pass the same finger down into the pelvis in the middle line (behind the uterus in the female and behind the bladder in the male), and pressing the tip of the finger against it, push out toward the floor of the pelvis, cut upon the tip of the finger as a guide, thus opening the peritoneal cavity from below. Next introduce the right forefinger through the perineum, and, guided and assisted by the left, hook the right finger around the gut and pull it downward and out through the perineal incision. Stitch the opening in the abdominal wall, then open the gut and suture its edges to the perineal wound in the manner described. Should any difficulties arise from mesenteric relations in bringing the bowel down from the pelvic brim (only in worse cases) to the perineum, the mesenteric attachments should be torn or cut through and the vessels tied. Whatever the nature or degree of malformation, etc., would be readily recognized and met by this suggestion."

The first operation in which the principle indicated by McLeod was applied appears to have been performed by Hadra, a German surgeon, in 1884.[105] In this instance the operator, after trying ineffectually to reach the rectal pouch through the perineum, opened the abdomen in the left groin, found a movable enteron, and easily guided it through a perforation made in the pelvic peritoneum to the anal wound, where it was sutured and

drained. The child stood the operation well and was improving rapidly, when, unfortunately, on the fourth day, it died suddenly from accidental asphyxia caused by the entrance of milk into the larynx.

The next case is that reported by Dr. W. S. Conant, of Boston (*Boston Medical and Surgical Journal*, March 24, 1893). Male infant, three days old; no meconium passed since birth. Urine limpid; temperature 100°; pulse 100; jaundice; abdomen much distended. No trace of anus present. Operation on day of examination, May 31, 1891, in Massachusetts General Hospital. Ether; incision, from middle of perineum to tip of coccyx, carried to the depth of one and a half inches. No gut recognized by impulse or by exploration with trocar through perineal wound. Without further perineal exploration laparotomy was then decided upon. An incision two and a half inches long was made in the left linea semilunaris. Some ascitic fluid escaped on opening abdomen. The distended gut was recognized on a level with the highest point of the perineal incision. It terminated about a quarter of an inch from the perineal incision, and was separated from it by a diphragmatic membrane which shut off the abdominal from the pelvic cavity. With a finger as a guide in the abdominal cavity a trocar was inserted into the rectal pouch through the perineal wound without opening the peritoneal cavity. Five ounces of meconium escaped through the canula. The abdominal wound was then closed. The canula left in the perineal wound was held in place with adhesive plaster. The child stood the operation well. About seven weeks after the operation the perineal orifice had to be stretched and a mass of fecal impaction dug out. The child lived until the last of August, or about three months after the operation, when it died of enterocolitis.

The perineal anus in this case evidently suffered from the usual tendency to recontraction which invariably follows cicatrization when the rectal mucosa is not sutured to the skin.

Another case which is recorded by Chaput, and which was presumably operated in 1891 or 1892, is detailed elsewhere in the section devoted to the sacral operation for imperforation.

This case illustrates the application of the combined abdominal and perineal routes. In another instance, operated by Stephen Paget in 1890, a successful attempt was made to perform a colostomy, and at one and the same sitting the operator guided a director through the bowel to the pelvic floor, and in this way succeeded in bringing out, through the sacral wound previously made, the blind end of the enteron, which was opened on a level of the skin and drained. The operation was successful in draining the bowels, but the child died two months afterward from diarrhœa. In Paget's case no sacral resection was attempted. We shall refer to the procedure adopted by Chaput and Paget again when dealing with Chassaignac's methods.

Fochier's case, which is also referred to in the section on the sacral operation, is not included in the class of the combined abdomino-perineal operations, because this surgeon simply performed a colostomy after failing to reach the gut by the sacral route, and did not attempt to restore the continuity of the bowel to the normal anal outlet.

XX.

Primary Exploratory Cœliotomy, Followed by Perineal Proctoplasty, in One Sitting.

Quite recently McLeod's proposition has been revived and put in practice, in a modified form, by Mr. Paul Delagenière, of Tours (*Archives Provinciales de Chirurgie*, t. xi. No. 7, Julliet, 1894). Delagenière differs in one essential particular from McLeod, and that is, that he would advise laparotomy as an *initial* procedure (*d'emble*), and not as the *finale* of previous perineal operations. He also differs from McLeod in preferring a lateral iliac incision instead of the median incision recommended by the former surgeon. This will be available if an artificial anus should become necessary. After exploring the region of the descending colon, and recognizing its terminal portion, he then drags it to the perineum, where an opening is made from below to receive it. Delagenière's studies in Lanne-

longue's laboratory on the bodies of six imperforate stillborn children led him to foresee certain difficulties in the application of McLeod's method, and caused him to modify it so as to give his (Delagenière's) suggestion a distinct individuality. Delagenière has no confidence in inguinal colotomy, which he believes always yields bad results. Hence he aims by his method to avoid the formation of an artificial anus at the groin at all hazards. He has been led by his researches to believe that the chief cause of the non-descent of the rectum lies in the shortening of the peritoneum, which imprisons the enteron and prevents it from reaching its destination. Whether right or wrong in this generalization, he found in his dissections (six cases) that by splitting the thick serous capsule which surrounds the terminus of the colon he was able to drag the gut out of its serous sheath (just as the glans penis would be excluded out of a phimotic prepuce), so that it (the bowel) was elongated with a gain of several centimetres from its terminal resting point, which, in five out of six cases, was situated below and to the inner side of the left sacro-iliac joint. He concludes from this that iliac colotomy is only indicated, as a rule, in cases of total absence of the rectum and sigmoid flexure. When the sigmoid flexure or its equivalent terminated in the pelvis, it did so in two ways: (1) as cul-de-sac held by a meso-colon, or, (2) as gut fastened down by peritoneum on its anterior surface only. In the first case it could be easily dragged to the perineum; and, in the second, the peritoneal coat would have to be incised, and the concealed gut dragged out of its serous sheath and guided into the pelvic floor, where a perineal wound would be ready to receive it. Delagenière then reports four cases which occurred in his practice and that of his brother, Dr. H. Delagenière.

In the *first* case (presumably in 1892) there was a total absence of the anus; unsuccessful efforts were made to find the rectal pouch by perineal incision for one hour, and the operation was discontinued. The child continued without relief two days longer (fourth day after birth), when a second operation was attempted by lateral cœliotomy. The rectal cul-de-sac was found opposite the left sacro-iliac joint. The serous capsule was then incised,

and the gut pulled out of its serous sheath and brought to the level of the perineal skin, where it was opened. The child died on the ninth day after the operation, from broncho-pneumonia. No peritonitis seen at autopsy.

Case II. Aged three days. Primary lateral cœliotomy. Rectal cul-de-sac found in brim of pelvis. Impossible to detach it from its connections without tearing their nutrient vessels; compelled to perform inguinal colotomy. Death on the third day.

Case III. (Operated by H. Delagenière, June 24th, 1893). Left lateral cœliotomy; incision three cms. in length. Exploration of pelvis with finger through the wound. Rectal cul-de-sac discovered at pelvic brim as a movable pediculated pouch. Then perineal incision made, through which the cul-de-sac was dragged and sutured. The abdominal wound was sutured with difficulty, owing to distention of bowels. Death five days after operation, from green diarrhœa.

Case IV. (P. Delagenière, December 17, 1893.) Perineal incision. The rectal cul-de-sac found by perineal dissection and sutured to the perineal wound. The original anal infundibulum was removed, and the rectum sutured in its place as in ordinary proctoplasty. Death on the third day in convulsions.

It must be noted, in explanation of this last case, that Delagenière believes that when the anal infundibulum is well formed, search for the enteron should be started from the perineum, because, according to his belief, it is almost certain that the cul-de-sac is in the pelvis and not far away. When there is no trace of anus, then he believes that laparotomy should be performed *d'emble*, as the cul-de-sac is likely to be far away. This view of the matter, however, is erroneous, and is not always sustained by experience, as we have had occasion to note elsewhere.

The following abstract of a case which is very graphically reported by Dr. Ch. Remy (*Journal de Clinique de Therapeutique Infantile*, July 25, 1895, No. 30), is, I believe, the latest reported case in which relief for imperforate anus was attempted by *a primary* exploratory laparotomy. Male, at term, in good condition, well formed, but completely imperforate anus. Puncture

through anus with needle and trocar fails to reveal meconium. Median incision six cms. long between umbilicus and pubis. Difficulties begin with the bladder which, though empty, is still in the way. Left hypogastric artery as large as a quill. Bowels give great trouble, owing to rapidly developing tympanitis. Their constant tendency to prolapse very annoying. Nothing could be seen with the eye, and he had to depend entirely upon the finger for exploration and recognition of colon.

The colon finally felt, and traced to the upper pelvic strait. The recognition of its precise mode of termination in the pelvis, made very difficult by over-crowding the pelvis with viscera and the narrowness of superior strait, which barely admitted the left index. The rectal pouch, however, felt as a flattened empty finger of a glove. The peritoneum appeared to cover its anterior surface without forming a mesentery. The operator had hoped that he would have been able to incise its serous covering, and thus liberate the gut from its attachment, but this was soon found to be entirely impracticable. Still hoping that he could drag it down to the perineal level, Remy perforated the anal cul-de-sac in the perineum, and introduced a long forceps with which he grasped the anterior portion of the rectal pouch, which he felt and pushed downward with his left index introduced through the upper abdominal incision. The traction of the forceps now succeeded in rolling the pouch upon itself, and enough of its anterior surface was grasped to permit the operator to suture it to the skin close to the anus. The pouch was now opened, but no meconium escaped. The abdomen was reopened, the colon was then seized at a higher point with long forceps and brought down to the wound, and a stylet introduced into its lumen, and through it to the perineal wound. Still no meconium came. It was evident that the traction on the gut occluded its lumen, as it curved over the upper pelvic strait. Over an hour had been taken up by these ineffectual procedures, and the abdomen was closed. A long forceps was left attached to the gut at its lower end and in the perineum, as an enterotome. Notwithstanding this great ordeal the child lived thirty-six hours without being relieved of the fecal retention.

The autopsy showed no signs of peritonitis. No other malformations. The enteron was separated from the anus only by the distance of one cm. Nevertheless, at the post-mortem the author removed the coccyx and the lower third of the sacrum, and found that he still could not reach the rectal pouch. The author's explanation, however, is no excuse for not forming an artificial anus with the cæcum or nearest distended loop, when he found that he could not succeed in emptying the bowel by the perineum.

But instead of criticising the management of this case, I feel that we must be very thankful to the author for his evident honesty and candor. Were all such experiences as carefully and candidly reported as this has been, the respective merits of the various operations that are suggested for the relief of this condition would soon be estimated at their just value, and we would cease to worry as to which is the best line of action when confronted by these cases.

The next case which is typical of the combined methods is the following, reported by Chalot, of Toulouse, under the heading, "Successful Case of Perineal Colostomy or Sigmoidostomy by the Combined Abdomino-perineal Route in Congenital Absence of the Rectum." (*Bull. et mem. Société de Chirurgie de Paris*, 1896, xxii., 318–331.

A female infant, aged six days, was operated February 17, 1896. Rudimentary anal cul-de-sac existed. Operation begun by perineal incision, which extended from the posterior vulvar commissure through the cul-de-sac to the sacrum. The posterior surface of the coccyx was denuded and the bone displaced backward; the finger introduced into the pelvis failed to reveal the rectal pouch. Without further exploration the perineal wound was plugged with iodoform gauze and a lateral incision made in the abdomen. The rectal ampulla was recognized in the left iliac fossa, on the inner border of the psoas, about ten centimetres long. It was coiled upon itself, and was quite movable owing to a redundant meso. A distance of five cms. separated the terminus of the colon above from the anal cul-de-sac below. The terminal colon was then partially detached from

its meso, which increased its length, and permitted the operator to guide it to the perineal opening, where it was secured, tapped, and drained. The abdominal wound was closed, the whole procedure consuming one hour. Complete recovery. The new anus acts well, though the question of fecal control had not been fully determined when the paper was published. Chalot concludes from this instructive case: First. That in all cases of ano-rectal imperforation, the first step is to incise the perineum and to begin a search for the missing rectum. In order to facilitate the search, the displacement of excision of the coccyx of the sacrum, or the parasacral operation of Vincent, may be adopted; second, if the rectal ampulla is not found, a lateral exploratory incision in the left iliac region should be made with a view of locating the terminus of the colon. This, if found, should be freed from its attachments sufficiently to permit it to be dragged to the perineal opening, and stitched, if possible, to the normal anal orifice, if this exists, after draining it. Third, it is only when the colon terminates too high to be detached and brought to the perineal opening, that an artificial Littré anus is permissible.

The last case which I have been able to find that illustrates the combined method is the one reported by J. W. Elliot, of Boston (operated May 1, 1896), in which the sacrum was resected before abandoning the search for the missing ampulla by the lower route. In this brilliant case the combined method permitted the operator to successfully restore the continuity of the intestinal canal to its normal outlet in the perineo-sacral opening. The case is fully described elsewhere in the section on sacral operations for imperforation.

XXI.

Summing up the evidence that we have been able to gather that has direct bearing on the combined abdomino-perineal operation, we find it reduced to the following cases:

Primary perineal or perineo-sacral exploration, followed by exploratory cœliotomy, on the McLeod plan, with modifica-

tions: 1. Hadra's case, recovery; 2. Conant's case, recovery; 3. Chaput's case, recovery; 4. Chalot's case, recovery; 5. Elliot's case, recovery; 6. P. Delagenière's case, recovery.

In all these cases the patients recovered from the operation, and are considered as operative successes, notwithstanding the fact that in Hadra's case the child died on the fourth day from accidental asphyxia. In Conant's case death in three months from entero-colitis. In Chaput's case in two months from diarrhœa. In Delagenière's case death on the ninth day from broncho-pneumonia. Both Chalot's and Elliot's cases were living and apparently in good condition at the time of the report, which was a few months after the operation in each instance. From this evidence we can state that the immediate operative results following McLeod's procedure are perfectly satisfactory, as the operation appears to have been well borne in the six cases in which it has been practised. It is well to state, also, that in all of these case the operations were performed early and by experienced surgeons and in hospital surroundings. The final history of these cases, however, points to the great mortality that prevails among these as in all other classes of defective children. It is proper to note, however, that in Conant's and Chaput's cases death was brought about by irritative conditions associated with imperfect perineal openings caused by the tendency to cicatricial retraction and the continued efforts made at dilatation. This simply reaffirms the lesson long ago taught by experience, that a well-formed inguinal anus is preferable to an imperfect one in the perineum.

When the rectal mucosa cannot be dragged to the surface sufficiently to unite it to the skin, it becomes a simple fecal fistula, and, like all such orifices, will constantly tend to cicatricial recontraction, and, like them, will be followed by all their complications.

XXII.

As to *primary* exploratory cœliotomy, whether median or lateral, with a view of expediting the recognition of anatomical conditions of the enteron, and, if possible, dragging it to the

perineal opening, which is made subsequently, *but at the same sitting*, we find little to recommend it, notwithstanding its theoretical plausibility. In the three cases reported the results may be summed up as follows: (1) P. Delagenière's case; death on the third day. Attempt was made to drag the colon to the perineum, but failed, then inguinal colotomy. This case, which is not an illustration of the combined method, but of inguinal colotomy, is simply mentioned here because the operator began his operation as a primary cœliotomy and tried his special plan of detaching the cul-de-sac from the mesentery, and failed. (2) H. Delagenière's case is a typical procedure of this kind, which was successful from the operative point of view, but death occurred on the fifth day from causes apparently not directly connected with the operation. (3) C. Remy's case; death in thirty-six hours from shock and sepsis.

The objection to primary cœliotomy apart from the scant evidence that can be quoted in its favor, is: (1) that in many, if not the vast majority of cases of imperforation, the rectal cul-de-sac will be found to be accessible by the perineal or perineo-sacral route, and that, therefore, a double traumatism and corresponding shock will be avoided if the exploration is begun by the perineum, especially if Stromeyer's suggestion and coccygeo-sacrotomy are resorted to early; (2) that if the exploration is begun by the upper abdominal route, instead of the perineum, two operations, viz., the abdominal and the perineal will have to be sustained by the patient, when one alone, the perineal, would have been sufficient in most cases; (3) the great advantage claimed for primary cœliotomy for exploratory purposes is the rapidity with which the anatomical conditions can be recognized. But this advantage has lost its weight since intraperitoneal exploration by a perineal wound has become a typical and practical procedure; (4) that the technical difficulties in the way of reaching the enteron by upper cœliotomy, of identifying it and guiding it to the perineal floor are much greater than is usually imagined by the inexperienced, cannot be doubted. This is well shown in Remy's, Chaput's, and other cases. The main cause of trouble is the tympanitic dis-

tention of the bowels and the packing in of the pelvic contents, and especially at the brim, which is plugged up as it were with the distended rectum, bladder, and other viscera. As a rule, the bowels must be tapped early in the operation, before the true conditions of the parts can be recognized, and before the blind end of the rectum can be pushed into the pelvis to its final resting place in the perineum. This compulsory enterotomy seriously complicates the situation by increasing the risks of peritoneal infection in the subsequent manipulations. Of course, if the operation is performed early, intestinal tympanitis scarcely exists, but even at a very early moment the enteron will be found quite full and blocking the way at the pelvic brim, so that tapping has to be resorted to before the blind gut can be guided to the peritoneum.

The only real advantage offered by primary cœliotomy is in the performance of an iliac anus in exhausted children that are brought to the operator at a late hour, when signs of intestinal sepsis and excessive tympanites demand the most expeditious methods of relieving the intestional tension and fecal stasis. Under such adverse conditions it cannot be denied that inguinal colotomy is the quickest and safest operation.

XXIII.

Preliminary Colostomy, Followed Immediately or at Another Sitting by the Restoration of the Perineal Anus.

The germ of this suggestion is found in a communication addressed by Martin (*le jeune*), of Lyons, to the *Société de Santé de Lyon* (t. i. p. 180; *Recueil des actes*, 1798), in which he proposed that in cases of congenital atresia ani an incision be made in the iliac region, and that the sigmoid be pulled out of the wound sufficiently to introduce a guide into its lumen, which would press the rectal cul-de-sac against the perineum. Martin's suggestion appeared to impress Velpeau in a favorable light, and he referred to it in his *Chirurgie Operatoire* (edition of 1832).

Velpeau also referred in later editions to Demarcquay's suggestion (made in 1863) to introduce a *sonde à garde*, or a guarded stylet, into the iliac opening through the gut, which would force the cul-de-sac against the perineum, and would fix it against the soft parts by driving the stylet through the intestinal walls, where it would act also as a guide. Nélaton and Huguier also appear to have thought of reconstructing the perineal anus by passing a guide into the blind end of the colon, but fortunately no one appears to have applied Martin's or Demarcquay's suggestion in practice. Huguier once introduced a sound (1864–65) into an inguinal anus, which actually entered the cul-de-sac, but no operation was performed.

The modern conception of this operation was for the first time clearly stated and realized in practice by Chassaignac, who made the suggestion at a meeting of the *Société de Chirurgie de Paris*, held February 20, 1856 (*Bull. et Mém. de la Société de Chirurgie*, tere serie, t. vi.) on the occasion of the exhibition of an enormous procidentia of the rectum and colon through an artificial anus in the inguinal region, made seven months previously, to relieve an imperforation in a newborn infant. Larrey, who presented the patient, asked for suggestions as to the treatment. Chassaignac said: "The first indication is to reduce the prolapse by the use of ice or taxis. After this has been accomplished, an effort can be made to re-establish the anal opening in the perineum by passing a sound into the lower or rectal end of the iliac opening, so that the intra-rectal guide thus introduced from above may press the rectal cul-de-sac against the perineum, where it can be easily reached by incision, and drained."

He had practised the procedure in a similar case, and had thus been able to establish the flow of feces through the normal outlet.

His claim to priority, as far as the actual performance of this operation is concerned, appears to be definitely established, at least so my researches appear to indicate, though French writers often attribute the first suggestion and operation to Lannelongue, who seemingly was not aware of Chassaignac's previous perform-

ance when he reported his case in 1884. After Chassaignac's allusion to his experience in 1856, the first case in which the iliac anus was utilized to explore the pelvis is Krönlein's case, in 1879, previously referred to. But this cannot be well included in this category, as the artificial anus in the groin was not the colon, but some other lesser bowel, which had been attached to the abdominal incision to give issue to the meconium. Chassaignac's suggestion was really put in practice for the second time on September 30, 1883, by Haynes (*Amer. Journ. Med. Sciences*, July, 1884), twenty-three days after a Littré colotomy had been made for imperforation. In this case the anus was well formed, and operative relief was attempted four days after birth by first puncturing the anal cul-de-sac. As the puncture gave negative results, colotomy on the Littré plan was at once resorted to. On September 30, 1883, under chloroform narcosis, a sound was passed through the inguinal opening into the lower colonic end, so as to push the rectal cul-de-sac against the perineal anus, which was made to bulge. A crucial incision was made over the guide, and a permanent ano-rectal communication was established. The child lived several weeks, but died of convulsions before the inguinal anus could be closed.

Lannelongue's case followed in 1884 (*Bull. et Mém. Société de Chirurgie de Paris*, n. s., x., 200, "*notes sur les cloisons congenitales du rectum; indications chirurgicales qui peuvent en être la consequence*"). In this paper he reports an instance of imperforation in which he was compelled to perform a Littré anus. Twenty days after the colotomy he introduced a sound through the colostomy opening, and by forcing the guide against the perineum succeeded in making a new perineal anus.

Sir William McCormac, writing in 1886 (London *Lancet*, July, 1886) and without any knowledge of the previous reports of Chassaignac and Lannelongue, said: "In those cases in which the bowel terminates at an unknown distance from the anus, the performance of Littré operation gives the child immediate relief, and is attended by comparatively little danger. Time is also gained for considering what the next step should be when the child is older and better able to have a further operative

procedure. From the opening in the groin the condition of the bowel can be ascertained with tolerable accuracy. When practicable the natural channel can be re-established with the greater advantage of having an exact guide to the position of the extremity of the gut," etc. The case of imperforation which served as a text for these remarks unfortunately proved by its fatal termination that this method was not devoid of some risk. In Sir William's case, right inguinal colostomy was done consistently with his views as an initial procedure. This was a success, but the child died some time after the operation from peritonitis, which, as the autopsy revealed, was due to an old accumulation of feces in the rectal cul-de-sac between its terminus and the iliac opening. This had excited an ulcerative rectitis, followed by fatal perforation. This case would probably have been relieved by a primary perineo-sacral exploration, and proves, at least, that the re-establishment of the normal rectal passage should not be delayed too long when probing indicates the enteron is long and is near the perineum.

Following after McCormac's experience, Demelin ("Imperforation de l'anus et du Rectum," *Rev. Int. de Toulouse*, 1895, i., 209–213,) reported the following case: The infant was born in Tarnier's clinic in Paris. On the day of birth a bare trace of the anus existed, otherwise external conformation of the body normal. Median perineal section; the coccyx was resected, and yet the ampulla could not be found. Chloroform was then administered, and an inguinal colostomy performed. A few days afterward an attempt was made to guide the rectal cul-de-sac to the perineal wound, but the distance was too great, and the iliac anus was allowed to remain. The patient recovered completely.

A. E. Maylard (in the *Glasgow Medical Journal*, 1896, No. 2, vol. xix, p. 120; also, in his *Surgery of the Alimentary Canal*, 1896, p. 669), reports an additional case. The child was seen in a deplorable condition from total imperforation eleven days after birth. Great tympanites and no vomiting. Double purulent ophthalmia. Normal anus. Operation May 6, 1896. Chloroform narcosis. A tenotome was thrust into the anal cul-de-sac for about one inch, and an incision back toward the sacrum.

Nothing was discovered. A left sigmoid anus was made. It was intended first not to open the bowel, but owing to the failure of the respiration, and critical state which the child seemed to be in, an opening was made into the loop, when a large quantity of gas at once escaped, and the child's condition immediately began to improve, and no further trouble occurred. Ten weeks after the final operation a bougie was passed down to the rectum from the artificial anus. The point was felt comparatively near the apex of the anal cul-de-sac, and an incision made upon it sufficiently large to admit of an India rubber tube being inserted. This was sufficiently long to admit of being passed through the rectum and out of the sigmoid anus, and the two ends fastened together.

On November 8th, the artificial (perineal) line of communication had contracted into such a tight stricture that it became necessary to divide it. A vulcanite rectal pessary was tied in, and this appeared to be having a beneficial effect, when the child contracted scarlet fever and died.

The last typical case of this kind is reported under the heading: "A Case of Imperforate Anus; Inguinal Colotomy," by Drs. Francis H. Stuart and J. C. Bierwirth, of Brooklyn, N. Y. (*Medical News* New York, January 30, 1897.)

"Female, June 4, 1895, anus well formed and occluded about one and a quarter inch above margin. Rectal ampulla could not be detected in the pelvis by vaginal examination. Inguinal colotomy (presumably on second day after birth). Tearing of sutures and prolapse of bowel four days after operation, necessitating anæsthesia and new sutures. October 15, 1895, over five months after first operation, a second operation performed with the view of restoring the anal outlet. Chloroform anæsthesia. The operation consisted in pulling down the blind anal pouch, securing it by silk sutures outside, which were given to an assistant to hold, and opening it sufficiently to admit the little finger. Then the invaginated lower portion of the original rectal pouch was reduced into the abdomen, and its blind end pushed by means of a large gum-elastic bougie toward the anal opening, and likewise secured by two lateral silk sutures which were held

by an assistant. Then the upper pouch was opened, and by means of Lembert sutures united to the opening of the lower anal pouch. After this, the bowel was flushed from the inguinal opening down through the anus, and was found to be entirely patent. Considerable depression, but child rallied and recovered from this operation. In six days the union between the rectal pouch and anal outlet was firm. The bowels continued to move, however, through the inguinal opening. The third operation, November 1 (two weeks later), to close inguinal anus. The mucosa was separated from the skin, inverted and the skin stitched over it. Coughing spell tore sutures, and the operation failed. November 12th, another operation to close inguinal anus. This time bowel completely dissected from skin, and opening in gut sutured by Lembert's method. Edges of skin incision refreshened and united with some tension. Time, four hours; great prostration; bowels moved by anal outlet *in perineo*. But anus had to be frequently dilated with finger. Final operative recovery. Later, general furunculosis; marasmus and death, April 20, 1896 (fourteen months after birth). Autopsy showed perfect annular line of union at junction of anal and rectal pouches.

This last report closes the list of cases in which a colostomy wound has been utilized after a variable period of time to complete the restoration of the perineal anus. This suggestion, which begins with Chassaignac's case, appears to be generally well supported by clinical evidence, as seven cases in which it has been more or less perfectly carried out (Chassaigne's, Krönlein's, Haynes', Lannelongue's, Demelin's, Maylard's and Stuart and Bierwith's), there were seven, or 100 per cent. operative recoveries.

XXIV.

In the preceding section the formation of the perineal anus has been considered in the light of a secondary procedure, to be performed at a subsequent sitting, when the colostomy is fully established (this is Chassaignac's suggestion). It is the operation of election which we would select in weak, exhausted, subjects, simply to meet the immediate demand for the relief of

intestinal tension and fecal stasis. It is not to be considered as a method of election when the patient is still strong, resting, and in condition to permit further exploration and manipulations, and when the rectal pouch is felt to be long and movable enough to permit its implantation by McLeod's and Delagenière's method at the normal perineal outlet. If, however, after the performance of colostomy under these critical conditions a favorable change should be observed in the condition of the patient (as may possibly follow after the drainage of the distended bowel), then the question arises, should we at once proceed to the immediate restoration of the normal anus by Chassaignac's method?

The clinical evidence that I have been able to gather on this point is limited to two cases, and these are not altogether unfavorable to the proposition. The first instance is one of two cases of imperforation reported by Stephen Paget in the *Transactions of the London Pathological Society* in 1890–91, vol. xlii, p. 136. The child was very weak and exhausted. An iliac colostomy was at once performed with immediale relief. A director was then introduced from above through the iliac orifice, and the rectal cul-de-sac was pushed out through the normal anal orifice, where it was sutured and drained. Death took place before the iliac anus could be closed from causes not directly connected with the operation.

In Chaput's case (elsewhere referred to in the list of sacral resections) a similar procedure was adopted and the child survived two months, when it was carried off by diarrhœa. The objections to this mode of procedure are:

1. That there is danger of perforating the thin rectal cul-de-sac with the probe or director while attempting to force it to the perineum, and that peritonitis may follow.

2. That the primary fixation of the colon in the groin may interfere with its subsequent mobilization, as appears to have been the difficulty in Chaput's case.

On the other hand, if the formation of the perineal anus is long delayed: (1) fecal stasis, with ulceration, may take place in the blind end, and fatal peritonitis may follow, as in McCormac's case; or (2) serious secondary operations may be

required to close the iliac anus as in Stuart and Bierwith's patient.

The advantages of a reasonable delay before attempting the final perineal proctoplasty are:

1. That the patient is given a better opportunity to recuperate and prepare for a complete operation.

2. That the cul-de-sac may spontaneously descend lower into the pelvis, and thus become much more accessible than at the time of the formation of the iliac anus (Krönlein's case).

XXV.

Summary of Operative Procedures.

We have now passed in review the various procedures that have been suggested with the view of overcoming intestinal obstruction caused by congenital ano-rectal imperforation. They may be grouped as follows:

A. Lower or infra-pelvic operations.

I. Involving the soft parts only.

1. Puncture or incision, with dilatation of thin membranous septa or diaphragms which separate the anal cul-de-sac from the distended enteron above.

2. Typical perineal proctoplasty (Amussat) with or without excision of the anal cul-de-sac, when this exists.

II. Perineal methods involving the pelvic skeleton, in order of severity.

1. Coccygeal displacement backward (Delens, 1874).

2. Median coccygotomy (Polaillon, 1875).

3. Median sacro-coccygotomy (Vincent, 1887).

4. Parasacral incision (Vincent, 1887).

5. *Single* osteoplastic sacro-coccygeal flap (Roux, 1889, Rydygier, Rhen, et al.).

6. Median sacro-coccygotomy with *bilateral* osteoplastic flaps (Heinecke, 1888, Kocher, Jeannel, Borellius, Morestin, Sieur).

III. In all of these procedures the peritoneum may be purposely and freely opened for exploratory purposes (Stromeyer's suggestion).

B. Upper or anterior abdominal methods.

1. *Primary* median or lateral exploratory cœliotomy, to recognize anatomical position of rectal ampulla and detach it from the peritoneum or mesentery, so as to create a perineal anus without colostomy (Delagenière, 1894).

2. *Secondary* median or lateral exploratory cœliotomy, with same object, after failure of *previous* perineal exploration (McLeod, Chalot).

3. *Secondary* inguinal colostomy (Littré), after failure of perineal exploration, with immediate attempt to restore continuity of rectal outlet to anus, after drainage of bowel, the rectal end being guided to the perineum by a probe introduced through colostomy orifice. (Chaput, Stephen Paget, and others.)

4. *Primary* colostomy without perineal exploration, with *secondary* attempt at restoration of continuity of bowel to perineal anus, at another sitting (Martin, Chassaignac, Lannelongue, McCormac).

5. Inguinal colostomy with permanent artificial anus (Littré) in left iliac region, or cæcostomy (Pillore), when the sigmoid flexure and colon are missing.

6. Enterostomy (Nélaton) when condition of patient is too critical to risk further exploration for rectum or colon; this can be applied successfully in sacral as well as in inguinal regions.

XXVI.

Conclusions.

The conclusions that can be drawn from the detailed study of these methods I would state as follows:

1. The most prevalent varieties of congenital ano-rectal anomalies, especially the types of imperforation, which most urgently call for surgical relief, are amenable to successful treatment by the perineal route. The cases that would justify primary colostomy are in the minority.

2. There is no external sign or physical criterion by which we may determine the actual internal anatomical conditions before

operation in the majority of cases. The presence or absence of the anus, the coexistence of pelvic (osseous) deformities, the evidence of fistulous communications with the ano-genital tract are all suggetive but unreliable indications of the anatomical situation and relations of the rectal ampulla.

3. Neither can we depend upon the introduction of guides in the bladder or vagina to determine the presence or absence of the enteron or to indicate its relative position in the hollow of the sacrum. The use of the exploring aspirating needle is also fallacious, and is often positively dangerous, owing to the risk of peritoneal contamination.

4. The direct causes of death in imperforate infants are: Stercoræmia, peritonitis, exhaustion, which rapidly set in from intestinal obstruction and stercoral stasis, and favor the absorption of toxins and the migration of intestinal micro-organisms. The influence of these causes in determining the results of operations is directly proportional to the length of time that has elapsed since birth, ergo: the earlier the operation is undertaken the better will be the result.

5. The resistance of the imperforate infant to traumatism is inversely proportional to the time that has elapsed since birth. The longer operative interference is delayed, the less will be the resistance to shock. The experiences related in this paper emphasize this well-established proposition and demonstrate that the newborn infant, when free from sepsis, compares most favorably with the adult in the capacity to resist traumatism. The experiences obtained in recent operations with *sacrectomy* and with the combined sacro-abdominal operations emphatically confirm the dicta of Bodenhammer (1860) and Giraldes (1865), who were foremost among the masters of the past generation to repudiate the tradition that the newborn infant is incapable of resisting severe traumatism.

6. The ideal result of operative interference in these cases is the restoration of the intestinal outlet in its normal situation or in the perineo-sacral-region with perfect functional (sphincteric) control.

7. The only way in which this result can be accomplished

without subsequent evil effects is by proctoplasty performed in accordance with Amussat's rules.

8. In order to insure the best functional results (sphincteric), the operator should endeavor to avoid unnecessary injury to the sphincter and levator fibres, by making strictly median incisions. When these muscles are absent or unavoidably injured, Gersuny's axial rotation of the bowel will probably prove the most effective preventive of incontinence.

9. The older methods of relief by puncture or incision, without proctoplasty, are no longer justifiable except in purely membranous obstructions, though even the vast majority of these require excision followed by proctoplasty.

Whenever there are dense strictures or diaphragms at the junction of the anus and rectum, it is indicated to resect the stricture or diaphragmatic portion and to suture the normal rectal mucosa to the anal margin.

10. The intraperitoneal exploration of the pelvis through a perineo-sacral opening, as suggested by Stromeyer, and since practised deliberately by a number of operators, is not only a legitimate procedure, but is one of the marked advances in the treatment of this class of cases.

11. Intraperitoneal exploration through the perineum should be systematically resorted to whenever a reasonable exploration of the subperitoneal tissues fails to reveal the rectal pouch.

12. The suggestions made to amplify the primary perineal incision by the removal of the coccyx (Amussat-Verneuil), excision of the sacrum (Kraske and his followers), by osteoplastic sacral flaps (Heinecke, Roux, et al.), and by parasacral incisions (Vincent, Zuckerkandl, etc.), are adjuncts of value both in facilitating the search for the enteron and in perfecting a proctoplasty, without dangerous tension, in the lower pelvic outlet.

13. It is preferable, as the method of election, in every case in which a perineal incision is insufficient to reach the enteron, to adopt the coccygeo-sacral route by a free median incision, though the cartilaginous coccyx and sacrum, as practised by Vincent and advocated by Sieur and others. If more space is required a bilateral osteoplastic flap can be easily made, which

will afford a larger entrance into the pelvis without permanently sacrificing the osseous framework.

14. The predisposition to rectal prolapse after sacrectomy should not be forgotten, and for this reason as little of the bone should be sacrificed as possible.

15. Primary exploratory laparotomies, with the view of identifying the anatomical relations of the enteron and guiding the bowel to the perineum from above, are not indicated as a rule; and thus far, at least in the few cases in which it has been tried, has not been followed by encouraging results, mainly, no doubt, because of the distended condition of the bowels and the crowding of the upper pelvic strait with the distended sigmoid and the rectal cul-de-sac, which compels enterotomy and a consequent greater risk of peritonitis before the rectum can be guided to the perineal level.

16 Since the advent of the perineo-sacral route, with or without intrapelvic exploration, the great majority of ano-rectal imperforations, irrespective of their anatomical peculiarities, are amenable to successful treatment by the formation of an artificial anus in the perineo-sacral region.

17. The perineal anus can be formed by attaching the terminal portion of the colon (rudimentary rectum) to the perineal or perineo-sacral wound, which is the ideal result; but in emergencies it is justifiable to attach the small bowel to the perineo-sacral wound.

18. The mortality of colotomy, in the statistics thus far recorded (whether primary or secondary), is greater than that of perineal or even perineo-sacral proctoplasty.

19. *a*. Inguinal colotomy, as a primary procedure, is indicated only when the infant is seen in an exhausted condition at a late hour, days after its birth, when stercoræmia, peritonitis and exhaustion are present, and life is ebbing fast. Then some sacrifice of ultimate benefits must be made for the sake of time. *b*. In every other condition the perineal incision should initiate the primary effort at relief.

20. Median or lateral exploratory laparotomy is indicated when, after the intra-peritoneal exploration through a perineo-

sacral incision, it is evident that the terminal cul-de-sac of the rectum or any portion of the colon cannot be brought down to the pelvic outlet, and only the small intestine is available for proctoplasty. Under such circumstances, if the condition of the patient is good, it is justifiable to perform exploratory laparotomy to identify the lowest portion of the bowel, if only to avoid the possibility of a physiological error. The aim of the operator should then be to guide the colon, the cæcum or the most available loop of ileum to the perineo-sacral wound, where it can be drained permanently with greater safety.

21. If for any reason the operator should prefer to make an iliac colostomy (Littré), he should always consider the possibility of restoring the anal outlet of the rectum by a secondary operation on the lines suggested by Chassaignac, Lannelongue and others.

22. The perineo-sacral anus, if properly performed, is almost certain to be voluntarily controlled in the course of time; the iliac anus is far more uncertain in this respect.

TABLE I.—CASES IN WHICH THE COCCYX HAS BEEN EXCISED IN PERFORMING PERINEAL PROCTOPLASTY FOR CONGENITAL ATRESIA ANI OR RECTI.

No.	Sex.	Age.	Year.	Operator.	Result.	Funct'l result.	External appearance	Complications.	Bibliographical references.	Remarks.
1	M.	48 hrs.	1842	Amussat.	Death (94 hrs.)	... .	No anus; vesico-rectal fistula.	.....	3me mem. sur la possiblité d'établir une ouverture artificielle sur le colon lombaire gauche sans ouvrir le peritoine chez les enfants imperforés, Paris, 1842. Examinateur medical de Paris, 1843, t. iii. p. 215. Translated by Bodenhammer in Treatise, 1860, pp. 248–50.	Autopsy proved that if pelvic search had been continued, rectum could have been reached, and colostomy would not have been required.
2	M.	2 days.	1864	Verneuil.	Recovery.	Good in 3 weeks.	Anus well formed.	.....	Bull et mem. Soc. de Chir., Paris, 1872, 3me Série, T. ii.	This is Verneuil's first case.
3	M.	3 days.	1866	Verneuil.	Death (48 hrs.)	.....	.....	Extreme exhaustion.	" " " " "	Fibrous cord existed in this case.
4	F.	A few hours.	?	Verneuil.	Death (10 dys after)	.....	No anus.	Born before term.	" " " " "	Death caused by jaundice and athrepsia.
5	M.	79 hrs.	1872	Verneuil.	Operative recovery.	.....	Anus well formed.	Born before term.	" " " " "	Death 35 days after operation, with complications.
6	M.	51 hrs.	1872	Verneuil.	Recovery.	Good.	No anus.	Enterovesical fistula.	" " " " "	
7	M.	A few hours.	1873	Tarnier,	Death (36 hrs.)	?	No anus.	Œsophag'l stricture.	Bul. Soc. Chir., 1873. p. 475.	
8	M.	48 hrs.	1874	Delens.	Recovery.	Good.	Anus well formed.	Umbilical hernia.	Ibid., Paris, Mar. 24, 1875. Verneuil's remarks, p. 245.	Prolapsus of rectum followed 6 months after.
9	M.	1 day.	1875	Polaillon.	Died next day.	.....	No anus.	Œsophag'l atresia.	Bul. Soc. Chir. Paris, July 14, 1875, and Gaz. Hebd. Med. et Chir., 1875, 491.	Many malformations present.
10	?	?	187?	Guyon.	Operative recovery.	?	?	?	Bul. Soc. Chir., 1872. Remarks following Verneuil's paper.	Failed to find rectum after coccygeal resection, and had to perform Littré.
11	M.	4 days.	1882	Byrd, W. A.	Recovery.	Presumably good	Anus imperfect.	Premat're birth.	Med. and Surg. Reporter, Philada., Dec. 9, 1882, vol. x. p. 7.	
12	M.	3 days.	1876	Gillette.	Recovery.	Excellent control.	Anus well formed.	?	Union Medicale, Paris, 1877, 3 s., xxiii. 689–700.	
13	M.	5 days.	1882	Anders.	Died next day.	.....	Anus well formed.	Peritonitis before operation	Ueber das operative verfahren bei congenitaler anales, etc. Arch. f. klin. Chir., Berl., 1882–3, xlv. 429–571.	
14	M.	.....	1884	Duret (de Lille).	Recovery.	Presumably good	Anus imperfect.	Urethral fistula.	Revue de Chir., 1885, p. 425.	
15	M.	.....	1892	Earle, S. T.	Recovery.	"	Anus formed.	.....	Maryland Med. Journ., Baltimore, 1892–3, xxviii. 131.	Choloroform administered.
16	F.	A few hours.	1895	Demelin.	Recovery.	"	No anus.	.....	Rev. Obstet. Inf., Toulouse, 1895, i. 209–213.	Failed to find gut by perineum and made a Littré.

TABLE II.—CASES OF ANO-RECTAL IMPERFORATION IN WHICH THE COCCYGEO-SACRAL ROUTE ALONE OR IN COMBINATION WITH ABDOMINAL SECTION WAS ADOPTED.

No.	Sex.	Age.	Year.	Operator.	Result.	Funct'l result.	External appearance	Complications.	Bibliographical reference.	Remarks.
1	M.	38 hrs.	1887	Vincent (Lyons).	Death.	....	No anus.	Contracted pelvis and numerous deformities	Thesis of J. Maître, Lyons, June, 1887.	The peritoneum opened to facilitate search for enteron. What was supposed to be the s flexure of colon was brought down to sacral wound and recognized as the terminus of the colon. This was sutured to sacral wound on level with highest point of sacro-sciatic foramen. Death due to imperfect development.
2	M.	24 hrs.	1887?	Vincent (Lyons).	Operative recovery.	.....	No anus.	.....	Thesis of J. Maître, Lyons, June, 1887.	Sacrum was divided up to its middle half after splitting the coccyx in two. Death thirteen days after operation from unknown causes while the child was doing apparently well.
3	M.	?	Mar. 1890	Ceci (Genoa).	Operative recovery.	.....	Anus normal in appearance; 1 cm. deep.	....	Rep. operazioni sul retto. Casi clinici e studi sperimentali, Genoa, 1891. Quoted by Sieur, Arch. Prov. de Chir., t. v. No. 9, Sept. 1896.	Sacrum cut transversely in its middle portion, and part below this excised with the coccyx. Death seventeen days after operation from capillary bronchitis.
4	M.	4 days.	Nov. 24, 1891	Burrell (Boston).	Perman't recovery.	Perfect sphincter control	Anus well formed.	.....	Reported by F. A. Higgins, Bost. Med. and Surg. Journ., May 14, 1896, pp. 485–486.	Coccyx and left lower half of sacrum excised.
5	M.	?	1892?	Chaput (Paris).	Operative recovery.	.....	.....	Colostomy.	Chaput, des operations sur l'intestin, etc. Paris, 1892, p. 131, quoted by Sieur, loc. cit.	Failing to reach the gut by perineum a vertical incision in the iliac fossa was made; then colostomy. An attempt to create perineal anus with guide introduced in colostomy opening which pushed rectal ampulla to pelvic floor. Coccyx and part of sacrum excised to reach it. Death two months after from diarrhœa.
6	F.	?	1892	Poisson (Nantes).	Perman't recovery.	.....	....	Prolapsus recti.	Trans. Soc. Med., Nantes, Dec 5, 1892, quoted by Sieur, loc. cit.	Sacrum resected for a distance of two or three centimetres.
7	?	?	April, 1893	Czerny (Heidelberg).	Death.	.....	.....	.....	Verhandl. Deutsch. Gesellsch. f. Chir., April, 1893.	Temporary osteoplastic resection of sacrum and coccyx by Rhen-Rydygier method. Death from peritonitis due to previous contamination with exploring needle.

No.	Sex.	Age.	Year.	Operator.	Result.	Funct'l result.	External appearance	Complications.	Bibliographical reference.	Remarks.
8	?	?	1893	Czerny (Heidelberg).	Operative recovery.	....	.....	A single kidney displaced in pelvis.	Verhandl. Deutsch. Gessellsch. f. Chir., April, 1893.	Same osteoplastic resection as in previous case. Failure to find rectum, displaced kidney in the way; iliac colostomy. Lived four weeks.
9	M.	2 days.	Jan. 14, 1894	Fochier (Lyons).	Operative recovery.	....	Normal anus.	Colostomy.	Commandeur, Mercredi Med., Paris, 1894, v. 605-607. J. Robert, Thesis, Lyons, 1896.	Colostomy after failure to find enteron by perineo-sacral route. Death on fourteenth day caused by green diarrhœa. Autopsy proved that if perineal desection had been continued rectal cul-de-sac would have been easily reached and sutured to perineal wound.
10	M.	40 hrs.	Aug. 28, 1894	Author (N. Orleans).	Perman't recovery.	Fair control.	Normal anus.	Whooping-cough; prolapsus recti after operation; other malformations.	Present article, and New Orleans Med. and Surg. Journ.. July, 1897.	Coccyx and lower part of sacrum removed. Marked rectal procidentia. Excision of prolapse twenty-eight days after operation for imperforation.
11	M.	5 days.	Dec. 28, 1895	White, E. A. (N. Orleans).	Death 22 hours after operation.	.....	No anus.	Vesico-rectal fistula.	Personal communication to the author.	Coccyx and a part of sacrum removed. After failure to find gut, laparotomy; connections between rectum and bladder separated; accidental puncture of bladder; peritoneum opened in perineal wound; pre existing peritonitis before operation.
12	F.	2 days.	May 1, 1896	Elliot, J. W. (Boston).	Perman't recovery.	.....	Anus well formed.	Abdominal section.	Med. News, N. Y., Oct. 17, 1896.	Left half of sacrum excised up to the third foramen. Failing to find gut in pelvis median laparotomy performed. After tapping and evacuating the distended enteron it was sutured to perineal wound.
13	M.	53 hrs.	Dec. 27, 1896	Keen, W. W. (Philadelphia).	Operative recovery.	Good.	Anus well formed.	Urethral obstruction; suprapubic cystotomy.	Therapeutic Gaz., Phila.. April, 1897, Personal communication to writer.	Death on eighteenth day from malnutrition. Cause of temporary retention of urine never determined; typical Kraske.
14	F.	2 days.	Feb. 3, 1897	Brault, (Algeria).	Operative recovery.	.....	Anus well formed.	Exhauston; bottle-fed.	Gaz. des Hôpitaux, Paris, Aug. 10, 1897, No. 90.	Simple perineal incision failed to find enteron; then, owing to extreme exhaustion, Littré colotomy; 20 days after colotomy a Kraske sacrectomy performed, and sacral anus created; death 10 days after this operation from inanition.

Bibliographic Notes and References.

1. Villar. Quoted in Labordères Thèse de Bordeaux. La rectorrhaphie circulaire avec fente longitudinale pour les retrecissements etendues et non valvulaires.

2, 3, Pean's and Jaboulay's cases quoted in Degouy's Thesis, Lyons, 1894.

4. Lannelongue. Note sur les cloissons congenitales du rectum; indications chirurgicales qui pauvent en être la consequence. Bull. et mem. Soc. de Chirurgie de Paris, 1884, N. S. x. pp 200–208.

5, 6, 7, 8 are quoted in Couty's Thesis. Contribution à l'étude des rectrecissement congenitaux du rectum et de leur traitement. Thèse de Paris, 1889.

9 is also referred to by 10. Mauclaire in "Considerations sur un cas de retrecissement congenital diaphragmatique ano-rectale; obstruction intestinale; rectoplastie; puis dilatation, guerison." Med. Infant. Paris, 1895, pp. 86–91.

11. Quoted by Marius Durand, Lyons, in "Traitement des malformations ano-rectales." Gaz. des Hôpitaux, Paris, December 1, 1894, No. 139, pp. 1301–1310. [I wish to acknowledge my indebtedness to the writer of this admirable article for many suggestions not fully acknowledged in the text.]

12, 13, 14, 15. Quoted by same. 16, 17, 18, by same, and by Giraldés, in article, Anus (Malformations). Nouveaux Dictionnaire de Medecine et de Chirurgie pratiques, Tome 12me., 1865.

19, 20, 21, 22. Quoted by W. Bodenhammer. A Practical Treatise on the Etiology, Pathology and Treatment of the Congenital Malformations of the Rectum and Anus. New York, 1860.

23. Roux. Imperforation de l'anus. Gaz. des Hôp., Paris, 1851, 3, 5, vol. vi. p. 434.

24, 25. Bodenhammer. Loc. cit.

26 Amussat. Histoire d'une operation d'anus artificiel pratiqueé avec succes par un nouveau procédé dans un cas d'absence congenitale de l'anus duivie de quelques reflexions sur l'obliteration du rectum. Gaz. de Paris, November 28, 1835. Also see reference in Table I. on Coccygectomies.

27. Goyrand, E. Études pratiques sur l'atresie et les malformations de l'anus et du rectum et sur les operations pour lesqueles ou peut remedier à ces vices de conformation. Gaz. Med. de Paris, 1856, pp. 509, 524, 538, 601, 639.

28, 29, 30, 31. Quoted by Giraldés.

32. Cripps, H. The Treatment of Imperforate Anus. British Medical Journal, London, 1892, vol. i. p. 1197.

33. Jacobi. Imperforate Anus. Medical and Surgical Reporter, Philadelphia, 1880, vol. xl. pp. 111, 337.

34. Anders, E. Ueber das operative verfahren bei congenitur analer und rectaler atresiæ. Lowie ausn undungen des rectum in der urogenitaler system. Archiv. f. Klin. Chirurg., Berlin, 1892–93, vol. xlv. pp. 489, 571.

35. Verhandl. Deutsch Gesellschaft f. Chirurg., 1893. See Table II. on "Sacrectomies."

36. Quoted by Durand. Loc. cit., and others.

37. Stromeyer. Handbuch der Chirurgie, Freiburg, 1844–48, 2 vols.

38. Luesrink. Atresia Ani, Fehlen des Rectum; operation nach der methode von Stromeyer. Deutsch. Zeitschrift f. Chirurg., Leipzig, 1872, vol. i. pp. 494–496.

39. Kronlein, R. M. Berlin, Klin. Woch., September 1, 1879, No. 35, p. 526.

40. Anders. Loc. cit.

41. Vincent. Lyon Medical, 1887, p. 408. Also in Thesis by J. Mâitre. Thèse de Lyon, June, 1887.

42. Robson, A. Mayo. Suggested Method of Operation on a Uniform Principle in the Treatment of Imperforate Anus, with a Case. Trans. Chirurgical Society of London, 1886–87, vol. xx. pp. 103, 105.

43. Joudeau, A. Absence de Rectum; aucune ouverture anormale de l'intestin; operation. Rev. Mens. des Mal. de l'enfance, Paris, 1891, vol. lx. pp. 459-461.

44, 45, 46, 47. Loc. cit., *ut supra.*

48. Froelich, R. De l'imperforation ano-rectale. Restauration du rectum dans tous les cas. Gaz. Hebd. de Med. et de Chirurg., August 4, 1894, pp. 375, 377.

49, 50. Commandeur. Un cas d'imperforation du rectum, modification du procédé operatoire par la voie perineo-sacral. Mercredi Medicale, Paris, 1894, vol. v. pp. 605, 607. See also Table II. on Sacrectomies.

51, 52. Loc. cit.

53. Dennis's System of Surgery, 1895, vol. i.

54. Esmarch, F. Die Krankheiten des mastdarmes und des afters, Stuttgart, 1887. Also in Bokai's Handbuch d. Kinder Krankheiten, Tübingen, 1877, vol. vi.

55. Loc. cit. Mâitre's Thesis.

56. Loc. cit., and Bodenhammer loc. cit.

57, 58, 59. Bodenhammer. Loc. cit.

60. Willems. Centralblatt f. Chirurgie, 1893, No. 19.

61. Witzel. Ibid., 1894, No. 40.

62. Gersuny. Centralblatt f. Chirurgie, 1889, No. 93.

63. Quoted by Sieur. Des Operations Pratiquées par la voie sacrée. Archiv. Provinciales de Chirurgie, T. V. 1896, June, *et seq.* [In addition to this article, I am under obligations to Dr. Sieur for valuable references communicated in a personal letter, which are elsewhere acknowledged.]

64, 65, 66. Rochard. Gaz. des Hôpitaux, Avril 5, 1862, p. 159.

67. Bodenhammer. Loc. cit. and New York Med. Journ., 1889, vol. xlix. pp. 562, 565.

68. Giraldés. Loc. cit.

69. Cripps. British Med. Journ., 1892, loc. cit.

70. Quoted by Durand. Loc. cit.

71. Verneuil. De la resection du coccyx pour faciliter la formation d'un anus perineale dans l'imperforation du rectum. Bull. et Mem. Société de Chirurgie, Paris, 1873, 3me. serie 2, p. 288, *et seq.*

72. Kocher. Deutsch. Zeitschrf. f. Chirurgie, Bd. xiii.

73. Lange. Annals of Surgery and Anatomy, Brooklyn, 1883.

74, 75. See Table I., Coccygectomies.

76. Hawkes. Proc. Connecticut Med. Society, 1889.

77. See Table I., Coccygectomies.

78. Kraske. Verhandl. d. Deutsch. Gesselschaft f. Chirurg, 1885, vol. xiv., Bd. 2, p. 464. Also Archiv f Klin. Chirurgie, 1886, vol. xxxii. pp. 563, 573.

79, 80. Authors quoted between these numbers are easily recognized as historic names in the evolution of Kraske's operations. Morestin's Thesis Des operations qui se pratiquent par la voie sacrée, Paris, 1894, and Sieur's recent contribution in the Archives Provinciales de Chirurgie, T. V., 1896, and Gerster (vide 97), are especially valuable from the historical point of view.

81. See Table II. Sacrectomies.

82. Chaput. Therapeutique chirurgicale des affections du rectum. Paris, 1896.

83. Zuckerkandl, E. Centralblatt f. Chirurgie, 1894, No. 45. Also Morestin and Gerster, loc. cit.

84. Wolfler. Wien. Klin. Wochen., 1889, Nos. 14, 16, 18. Also Morestin and Gerster, loc. cit.

85. Heinecke's operation. Munch. Medizin. Woch., 1888, No. 37. A T-shaped external incision dividing the sacrum and coccyx along the lines of the external incision, thus producing two lateral, triangular, osteotegumentary flaps which are to be replaced and sutured after the rectal operation is finished. Heinecke's operation was modified by Kocher (Ard: Beitrage zur statistik der rectum carcinome, Deutsch. Zeitschrift f. Chirurgie, vol. xxxii.), with a view of enabling the surgeon to divide the sacrum above the 3d sacral foramen without injury to the 3d and 4th anterior sacral nerves. Gerster: Trans. Amer. Surg. Assoc., 1895, vol. xiii. Also see Fig. in text.

86. Roux's operation (Morestin's Thesis). The incision is shaped like the figure <. The horizontal limb crosses the middle line below the third sacral foramen, and forms an osteoplastic flap which is turned toward the left. (See No. 2, p. 518.)

87, Billroth, 88, Rhen, 89, Rydygier, described and performed almost identical operations, referred to by Gerster as the Billroth-Rhen-Rydygier operation. It is like Roux's procedure, a typical single osteoplastic flap operation, only the line of the incision is reversed.

90, 91. See 85.

92. Jeannel's operation. Bull. Société de Chirurgie de Paris, 1890. Quoted by Morestin and Sieur, loc. cit. In this operation two osteotegumentary flaps are formed by making a median sacral incision which is crossed by two horizontal sections, the upper on a level with the 3d sacral foramina; the lower with the sacrococcygeal joint; thus two solid bilateral, square flaps are formed.

93. Gussenbauer's operation (Verhandl. Deutsch. Gesselschaft f. Chirurgie, 1893) is a primary median sacrococcygotomy, with transverse section of the sacrum on a level with the third sacral foramina. It forms two solid triangular, bilateral, flaps. It is very much like Heinecke's operation, except that this operator reflects only one osteoplastic flap, which includes the left half of the coccyx and part of sacrum (Sieur). Morestin's operation is almost identical with this as far as the formation of the bilateral osteoplastic flaps are concerned.

94. Borelius. Wien. Klin. Woch., 1894, p 249. The osseous sections in this operation run through the sacrum diagonally from the lower margin of the third left sacral foramen to the lower margin of the fourth right sacral foramen; an osteotegumentary flap is formed which is reflected with the coccyx to the left.

95. Morestin's operation (Morestin's Thesis, loc. cit.) aims at the most conservative treatment of the soft parts, and accomplishes this by closely adhering to the median line. The coccyx is split in two, and with it the fifth sacral vertebra. The two halves of the fifth sacral vertebra are disarticulated with the chisel and then turned over on each side, with the attached coccygeal halves as solid bilateral flaps. Heinecke's, Kocher's, Jeannel's, Morestin's and Sieur's operations are also osteoplastic sacro-coccygotomies. They differ in minor details, but they are essentially alike in the important fact that they form movable osteoplastic flaps by cross sections at various levels.

96. Kammerer, F. Cases of osteoplastic resection of the sacrum. Medical Record, New York, July 28, 1894.

97. Gerster, A. The Operative Treatment of Rectal Cancer. Trans. Amer. Surg. Assoc., 1895, vol. xiii., and Annals of Surgery, 1895, vol. xxii., pp. 485, 501.

98. Morestin. Loc. cit.

99. Taylor, E. H. The Operative Treatment of Cancer of the Rectum. Annals of Surgery, April 1, 1897, vol. xxv., No. 4.

100. Sieur. Archives Provinciales de Chirurgie, loc. cit.

101. Delbet, P. Des suppurations pelviennes. Paris, 1891.

102, 103. Quoted by Sieur, p. 335. Arch. Prov. de Chirurgie, June, 1896, vol. v., No. 6.

104. Ducuron, J. M. J. B. Contribution à l'étude du traitement des imperforations ano-rectals et de la conduite a teuir dans les cas ou l'on ne peut atteindre l'ampoule rectale par le perinée. Thèse Bordeaux, 1889.

105. Hadra. Berlin Klin. Woch., 1885, No. 7.

NOTE.—Other references are given in Tables I. and II., and are also interpolated in the body of the text.

A SUCCESSFUL CASE OF URETEROPLASTY FOR INTERMITTENT HYDRONEPHROSIS.

By MAURICE H. RICHARDSON, M.D.,
BOSTON.

THE principle carried out in the following case is that of the Heinecke-Mikulicz operation of pyloroplasty for stricture of the pylorus. To Fenger, of Chicago, however, I am indebted for the suggestion that this principle may be applied to strictures of the ureter. Its application to the treatment of an obliquely inserted ureter compressed by the distended pelvis of a hydronephrotic kidney naturally followed a careful study of Fenger's paper on this subject (Vide *Annals of Surgery*, vol. xx. p. 257).

The patient was a nurse, a single woman, aged twenty-nine years, of good family history and of previous good health. For eight or ten years she had had occasional attacks of pain in the right side of the abdomen under the ribs.

For two years before my first examination (February 20, 1896) she had noticed with the attacks of pain a swelling in the right side. With subsidence of the pain, the swelling was observed to disappear; at the same time a remarkable increase was noticed in the amount of urine. These attacks would come on at intervals of six months.

At my first examination I was unable to find any physical evidence of disease. There was no tumor; the urine was normal. I was inclined to look upon the case as one of neurasthenia. I sent her for observation to the Massachusetts General Hospital.

Careful and repeated examinations failed to reveal any physical evidence of renal or other tumor. Shortly after admission to the hospital she had a slight attack of pain; a small tumor could be felt in the region of the gall-bladder. On the following morning she passed twenty ounces of urine, with relief to the pain and with subsidence of

the tumor. Soon after this the tumor reappeared. It was globular, resistant, and somewhat tender. Its situation was that of the gall-bladder. After prolonged observation it was deemed advisable to explore the region of the tumor. This operation was performed on March 17, 1896. The gall-bladder was found to be normal. In the region of the right kidney there was a tumor connected with the kidney. It was retro-peritoneal, somewhat elastic, about the size of a small cocoanut. It seemed clearly a hydronephrosis. No operative treatment was deemed best at the time.

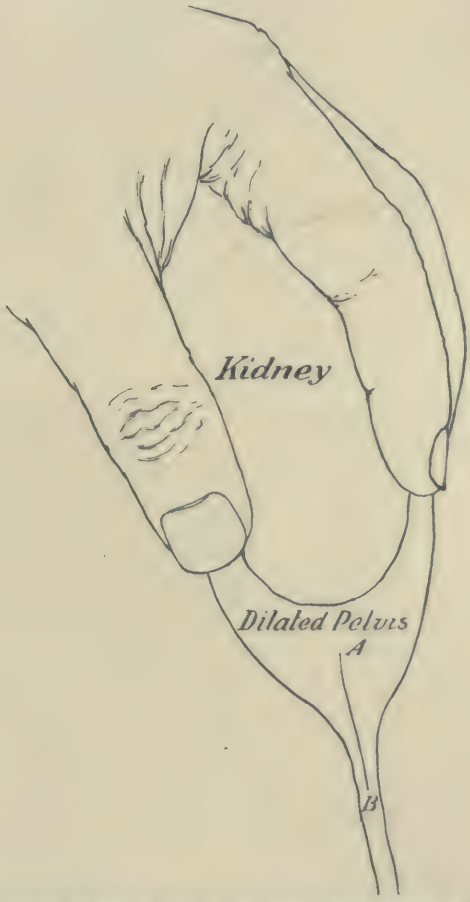
FIG. 1.

Diagrammatic view of kidney, pelvis, and ureter, showing the way in which the ureteral mouth is compressed and obstructed by the dilated pelvis.

The patient made a good recovery from the exploration. She left the hospital and resumed her work. Renewed attacks of pain brought

her again to me. I determined to explore the kidney from the side, to ascertain the relation of the pelvis and the ureter, to make out if possible the cause of the obstruction, and to apply, if possible, Fenger's method of plastic treatment of the ureteral orifice.

FIG. 2.



Showing the kidney on the stretch, held in the surgeon's left hand. The space between the pelvis and the compressed ureter is obliterated, and easily permits the longitudinal incision, *A. B.*

This operation was undertaken on November 11, 1896. The kidney was exposed retroperitoneally by a lateral incision through the right

flank. The ascending colon and overlying viscera were pushed forward sufficiently to give a clear view of the kidney. The ureter was found inserted into the inner convexity of the renal pelvis. From its insertion until it cleared the lower border of the tumor it was so placed as to be flattened and obstructed. (Fig. 1.)

The renal pelvis was excessively distended, the ureter collapsed and compressed. The kidney and its pelvis, with the ureter, were drawn out of the wound as far as possible until the ureter was straightened out from its attachment to the renal pelvis. The space between ureter and pelvis was thus obliterated, and the ureteral orifice therefore patent. (Fig. 2.)

FIG. 3.

Lateral view after suture, showing the partially collapsed pelvis, the anterior half of the transverse suture line, and the new funnel-shaped ureteral mouth.

The object of the operation was to change the pelvic outlet into the ureter from an oblique and easily-compressed valvular insertion into an unobstructible and funnel-shaped mouth. (Fig. 3.)

Fenger brought about this result by an intrapelvic plastic operation. In this case it seemed quite as promising and efficient a procedure to obliterate the space by converting a longitudinal external incision,

extending through pelvis and ureter, into a transverse one ; in applying, in other words, the principle of pyloroplasty to the ureteral mouth, as suggested by Fenger in ureteral strictures (*loc. cit.* p. 276).

The technical difficulties were easily overcome. The incision, about an inch in length, half in the pelvis and half in the ureter, was converted into a transverse line by fine silk sutures applied to the outer coats as in the Lembert intestinal suture (see Fig. 3).

Before closing the suture the renal pelvis was explored with the finger, with negative result. A bougie was passed into the bladder without obstruction. A small gauze wick was left in contact with the line of suture.

The patient made a rapid recovery. There was at no time any leakage of urine. A small sinus persisted for some months.

This patient was exhibited before the Massachusetts General Hospital Clinical Society and before the Massachusetts Medical Society in June, 1897. She was in perfect health ; there had been no pain ; no tumor could be felt ; she was able to do her full amount of work.

ORIGIN OF APPENDICITIS.

By DUDLEY P. ALLEN, M.D.,
CLEVELAND, OHIO.

In operating for appendicitis three conditions have so frequently attracted my attention that it has seemed to me they must have some causative relation to the disease. These conditions are, first, a bend or flexure of the appendix itself; second, a stricture of the appendix on the proximal side of the inflamed portion, and third, a great increase in thickening of that portion of the appendix distal to the point of flexure and stricture. It may be added that the point of flexion is slightly distal to the point of stricture. The explanation which has occurred to me is as follows. The first step in appendicitis is a bend in the appendix. This causes retention of mucus, and the effort of the appendix to empty its contents into the bowel produces increased pressure at the point of flexure. As a result of the pressure inflammation of the mucous membrane takes place. An organic stricture is at length produced. The increased thickening of the distal part of the appendix is due to the increased work placed upon its muscular tissues to enable it to empty itself. When by tightening of the stricture the appendix is no longer, even by increased effort, able to empty its contents into the bowel the danger of distention to a point of perforation becomes imminent.

I have thus stated briefly, in the beginning of this paper, the conclusions at which I have arrived, in order that the line of argument leading to these conclusions may be more easily followed. Before entering upon the discussion of the question it is desirable to present an illustration showing the histological structure of the appendix.

Fig. 1 shows a transverse section of a normal appendix. Beginning with the peritoneal covering the appendix divides itself into five definite layers; first, the peritoneum, second, the longitudinal muscular fibres which run parallel to the long axis of the appendix, and which in the transverse section are, of

FIG. 1.

Normal appendix. Transverse section.

P Peritoneum. *L. M.* Longitudinal muscular fibres. *C. M.* Circular muscular fibres. *S. M.* Submucous tissue. *M.* Mucous coat. *C. L.* Crypts of Lieberkühn. *S. F.* Solitary follicles.

course, cut cross-wise. The third layer is a bundle of circular muscular fibres surrounding the entire appendix, the fourth is made up of loose connective tissue, which may be called the submucous layer. The fifth layer, or mucous coat, lining the interior of the appendix, is made up of two structures: first, the

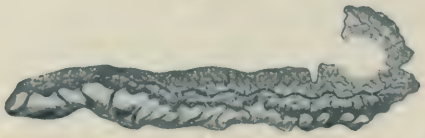
crypts of Lieberkühn, occupying a part of the surface, and the solitary follicles corresponding to Peyer's patches of the ileum. In different specimens of the appendix the bundles of longitudinal muscular fibres vary, being considerably thicker in the region of the mesoappendix and in the part of the appendix opposite to it than in the intervening portions. In case the appendix is much thickened by inflammation, there is sometimes an inflammatory layer to be found between the peritoneum and the longitudinal muscular fibres.

This short description will enable us to follow the illustrations. I will now return to the consideration of the conditions which have already been mentioned as constantly recurring in appendicitis. The first of these is the bend. I have operated upon many patients who were invalids, having recurring attacks, accompanied by vomiting, a moderate degree of fever, localized pain, tenderness on pressure, and sometimes a feeling of distention. I say a feeling of distention, because the pain produced by palpation is such as to cause rigidity of the muscles over the cæcum, which may be deceptive. The cases spoken of have all been operated in the interval between attacks. In opening down upon such cases I have repeatedly found the appendix lying free in the abdominal cavity, without adhesions, without any thickening of the peritoneal coat, and without any external evidence of present or past inflammation. I have universally, however, found the appendix bent at an angle to such a degree as to impede the passage of material from the distal to the proximal portion. This bend to be appreciated must be observed as the appendix lies in situ in the abdominal cavity, since the bend often disappears after removal, although the appendix easily falls into this bent position again. In connection with the bend the distal portion is usually thickened, elastic, and fluctuating. Upon cutting open the appendix under such circumstances, it will be observed that the wall of the distal portion is much thicker than the proximal portion. There is also a stricture, often amounting to occlusion at the point of flexion. The statement made is from observation upon appendices in which there has been no evidence of inflammation pertaining to either the mesoappendix or peri-

toneal coat. In some advanced cases of appendicitis, bearing evidence of inflammation of the peritoneal coat, and in which, perhaps, ulceration and perforation have taken place, the adhesions are so great that it is often impossible to observe whether flexion be present or not. Under these circumstances, however, the distal portion of the appendix is greatly thickened; there is also present a stricture, and if ulceration and perforation have taken place, the perforation is distal to the point of stricture. In order to trace the significance of these observations I have made a series of drawings, most of them being of microscopic sections.

Fig. 2 is the exact reproduction of an appendix removed from a young lady. She had suffered from repeated attacks of ap-

FIG. 2.



Appendix removed on account of repeated attacks of inflammation. Drawing reduced one-third. Shows extreme flexion and stricture.

pendicitis, and had been unable to do anything for a long period, having been confined to the bed six weeks, and an invalid for three months. Since the removal of the appendix the young lady has been entirely well. Careful examination after removal disclosed the fact that the appendix was bent upon itself, and that there was a very tight stricture, as shown in the illustration, less than one inch from the cæcum. Beyond this point of stricture the appendix was larger than on its proximal side, and its walls were considerably thickened.

Fig. 3 is a longitudinal section of the same appendix, and an effort was made to select the microscopic section corresponding most closely to that through the central lumen of the appendix. The lumen does not show perfectly in the section, and fails to do so simply because it had become entirely obliterated. On examination of this specimen and of the point of stricture it will be observed that the peritoneal covering is intact, that the mucous lining is destroyed, and that the muscular coats are

almost gone. On comparing the portions of the appendix proximal and distal to the stricture, it will be seen that the distal por-

FIG. 3.

Same appendix as Fig. 2.

Microscopic section shows lumen closed at stricture. Proximal portion is normal. Distal portion distended and hypertrophied. *P. P.* Proximal portion. *D. P.* Distal portion.

tion is very greatly thickened, this thickening involving all the coats except the peritoneum. The thickening of the various coats of the appendix beyond the point of stricture will be seen more plainly in another illustration.

Fig. 4 is a transverse section of the same appendix represented in Figs. 2 and 3. The comparative thickness of the various coats is not so accurately shown in the drawings as to permit of comparison, but means have been taken to make measurements which are absolutely accurate, and the relative thickness of the different coats will be illustrated by another method.

Fig. 5 shows even more clearly than Fig. 2 the evidences of stricture. This appendix is cut open longitudinally. The small

projection at one extremity of the illustration represents the stricture. This appendix was removed during an operation for oöphorectomy. The appendix projected in an erect position

FIG. 4.

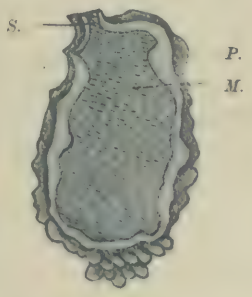
Same appendix as Fig. 2 and Fig. 3.

Transverse section of distal portion. Shows thickening of combined longitudinal and circular muscular coats when compared with Fig. 1. Longitudinal muscles markedly hypertrophied near mesentery. *P.* Peritoneum. *L. M.* Longitudinal muscular fibres. *C. M.* Circular muscular fibres. *S. M.* Submucous tissue. *M.* Mucous coat. *M. S.* Mesentery.

into the abdominal cavity, and was enlarged and very tense. By good fortune the woman's husband stood by the operating-table, and although the patient's history had been taken with very

great care, she had said that her only pains were those referred to the ovarian region. The woman was a sufferer from hystero-epilepsy, and for this reason her history was not as clear as it might otherwise have been. The husband on being questioned said that his wife had suffered from repeated attacks of pain and swelling in the region of the cæcum, and that the physician had never been able to make out to what these attacks were due.

FIG. 5.



Appendix found at operation for oöphorectomy.

Proximal end occluded by stricture. Distal end much distended with muco-pus. Drawing represents appendix laid open longitudinally. *P.* Peritoneal surface. *M.* Mucous surface. *S.* Stricture.

With his permission the appendix was removed. It was bent at an angle with the cæcum, and upon being opened the distal end was found to be distended and its walls thickened. The illustration shows that at the point of amputation the mucous membrane is so contracted that its lumen is completely occluded. This appendix, as has been said, lay free in the abdominal cavity, without the slightest evidence of inflammation of its peritoneal coat or of its mesentery.

Fig. 6 is especially instructive. While examining a patient who had suffered from pelvic inflammation, slight resistance was noticed above Poupart's ligament, and although no history of attacks of pain resembling appendicitis could be obtained, a sufficient suspicion of its presence had been aroused to lead me to examine the cæcal region. The specimen here presented shows the condition of the appendix. It projected in an erect posi-

tion from the inner side of the cæcum toward the median line, being free from adhesions. On it were a few flakes of yellow plastic lymph. The proximal portion of the appendix was normal. A little beyond the central portion was a stricture, and just beyond this a bend. The distal part was much distended, and the inflammatory process was so acute that the walls were just on the point of general gangrene. Within a few days perforation of the appendix must have occurred.

FIG. 6.

Appendix found at operation for oöphorectomy.

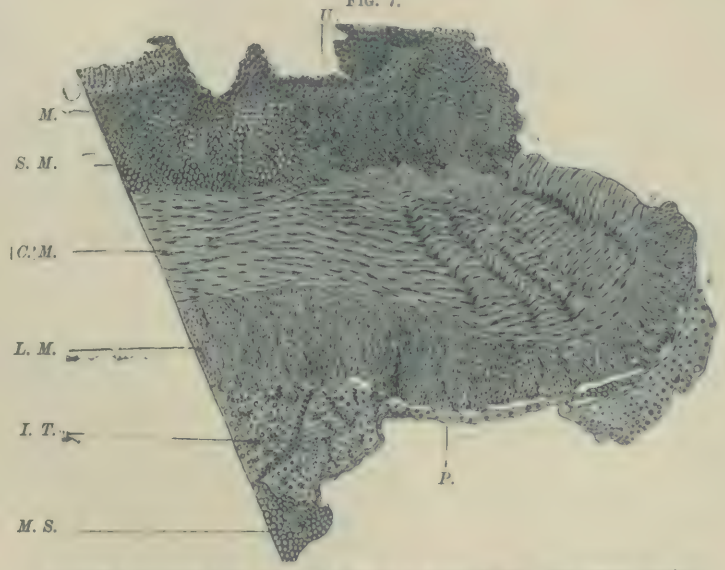
Proximal portion normal. Distal portion almost gangrenous. The stricture completely occludes lumen. Distal portion was much distended, very tense and fluctuating. *P.* Proximal end. *D.* Distal end, almost gangrenous. *S.* Stricture.

This specimen also shows the tendency of great distentions to straighten the appendix. This will be better appreciated by comparing this specimen with Fig. 2, which was not so greatly distended. Doubtless if the appendix had been cut open before removal it would have fallen into the flexed position. Rarely will an operator have opportunity to remove an appendix in such an advanced stage of disease, unless directed to the operation by marked symptoms of local inflammation. The specimen shows how rapidly fatal attacks of appendicitis may occur.

Inasmuch as specimens here illustrated, together with many others, show the presence of both strictures and bending of the appendix, without evidence of inflammation either of its peritoneal covering or mesoappendix, the question arises which is the primary process? Is the bending the result of the stricture, or is the stricture the result of the bend? To be sure, ulceration and cicatricial contraction of the interior coats of the appendix could produce a bend of this organ. It is equally true that a

bend of the organ could produce ulceration and inflammation of the interior coats. It is my belief that the bend is primary and the ulceration the secondary process. The reason for this belief will appear further on. This much, however, seems evident, that if the process of ulceration of the interior of the appendix were

FIG. 7.



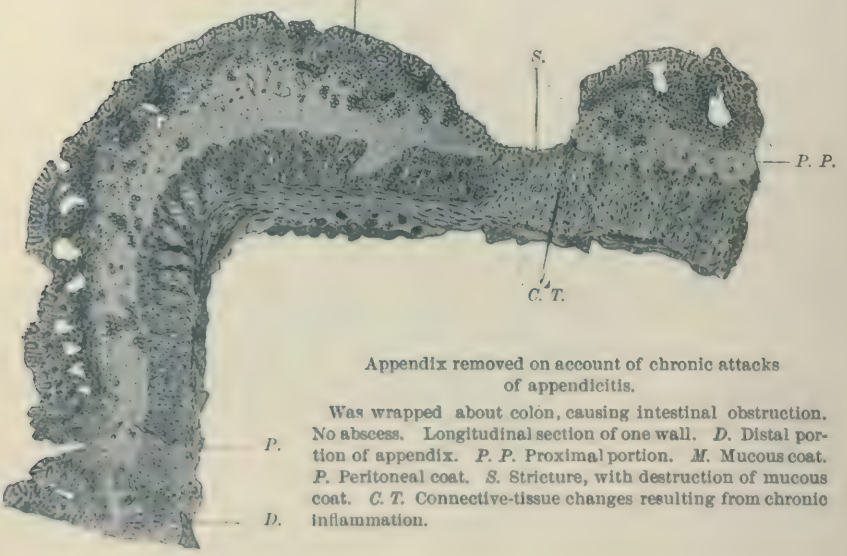
Appendix removed after repeated attacks of appendicitis. Transverse section.

Was perforated and had localized abscess. Mucous coat shows beginning ulceration and destruction. Muscular coats greatly hypertrophied. *P.* Peritoneum. *M. S.* Mesentery. *I. T.* Inflammatory thickening, made of newly formed tissue. *L. M.* Longitudinal muscular fibres. *C. M.* Circular muscular fibres. *S. M.* Submucous tissue. *M.* Mucous coat. *U.* Ulceration.

primary and the flexion were secondary, we would expect to find a folded condition of the mesoappendix on account of the new position at the appendix. If, on the other hand, the mesoappendix corresponds in length to the bent appendix, it must show evidences of shortening resulting from some cause, as, for instance, inflammatory thickening or contraction. As a matter of fact, however, under these circumstances there is absolutely no evidence of an inflammatory process in the mesoappendix, and it seems to correspond to the position of flexion in which the appendix is found. To show more thoroughly the process

of ulceration I have made Fig. 7. This shows the beginning process of ulceration of the mucous membrane, very much as it appears in cases of typhoid fever attacking Peyer's patches. In this case the inflammatory process has destroyed the mucous

FIG. 8.



Appendix removed on account of chronic attacks of appendicitis.

Was wrapped about colon, causing intestinal obstruction. No abscess. Longitudinal section of one wall. *D.* Distal portion of appendix. *P. P.* Proximal portion. *M.* Mucous coat. *P.* Peritoneal coat. *S.* Stricture, with destruction of mucous coat. *C. T.* Connective-tissue changes resulting from chronic inflammation.

FIG. 9.

Appendix removed for recurring attacks.

No abscess or perforation. Longitudinal microscopic section at point of stricture. Shows formation of connective tissue at stricture. *P.* Proximal portion. *D.* Distal portion.

coat, particularly that pertaining to the solitary follicle, and the specimen shows a beginning inflammatory infiltration of the submucous coat.

Fig. 8 shows one wall of an appendix in which the process of ulceration has gone on to the entire destruction of the mucous and submucous coats. The transformation into connective tissue has gone on to such a degree, in fact, that the muscle itself is almost entirely destroyed.

FIG. 10.

Same appendix as Fig. 9.

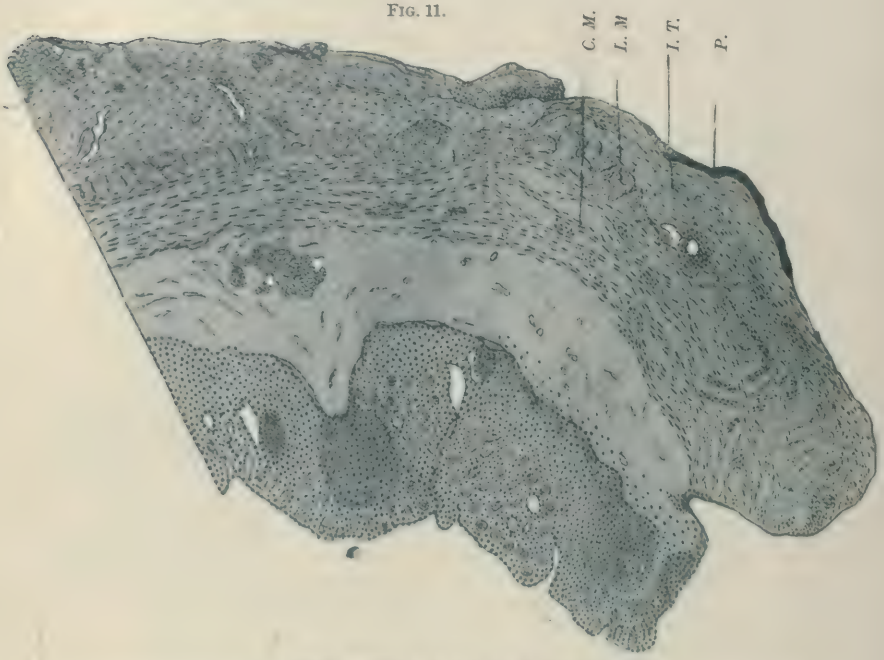
Transverse section made proximal to stricture. Drawing made by camera-lucida, and may be compared with Fig. 11, which is drawn to same scale. *L. M.* Longitudinal muscular fibres. *C. M.* Circular muscular fibres.

Fig. 9 is a longitudinal section of an appendix showing the same process. This illustration shows extensive destruction of the mucous coat, and in the central portion it has entirely disappeared. It will be noticed, also, that the muscular tissue has undergone extensive connective tissue changes.

Figs. 10 and 11 are transverse sections of the same appendix as that shown in Fig. 9. They are made with absolute accuracy so far as their proportions are concerned, and are transverse sec-

tions of the portions of the appendix proximal and distal to the stricture shown in Fig. 9. It will be noticed that all the layers of the distal section (Fig. 11) are considerably thicker than those

FIG. 11.



Same appendix as Fig. 9 and Fig. 10.

Tranverse section made distal to stricture. Drawing made with camera-lucida, and may be compared with Fig. 10, which is drawn to the same scale. Showing great hypertrophy of muscular coat. *L. M.* Longitudinal muscular fibres. *C. M.* Circular muscular fibres. *I. T.* Inflammatory thickening. *P.* Peritoneum. The muscular coats are much thicker than those of Fig. 10.

of the proximal section (Fig. 10), and, inasmuch as these drawings are accurate in their relative proportions, they illustrate the hypertrophy of that part beyond the stricture.

Fig. 12 as well as Fig. 7 are illustrations of appendices in which there were repeated attacks of inflammation, and Fig. 12 shows the production of the inflammatory area between the peritoneal covering and the longitudinal muscular fibres. Both Figs. 7 and 12 show great hypertrophy of the longitudinal and circular

muscular coats compared with Fig. 1. This is so marked as immediately to attract the attention.

Figs. 13, 14, and 15 are taken from one appendix, and illustrate the obliteration of the lumen which may follow an inflammatory process. Fig. 13 is a longitudinal section of the appendix, showing the portions of the appendix which are proximal and

FIG. 12.

Appendix removed after repeated severe attacks.

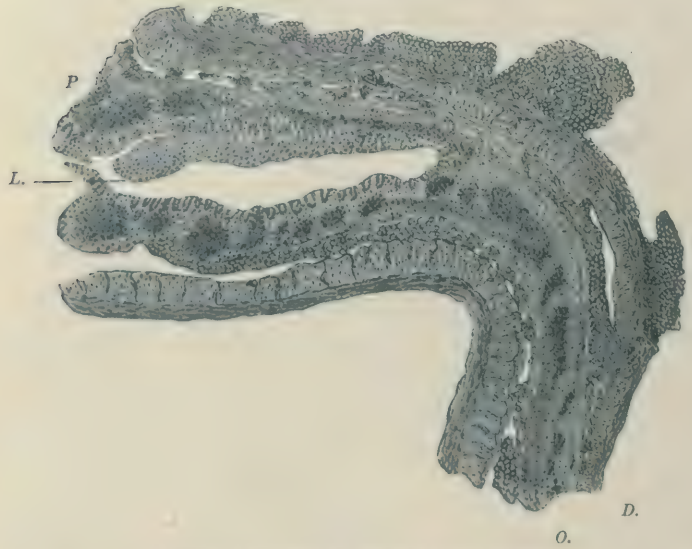
Perforation and localized abscess. Transverse microscopic section distal to stricture Shows great hypertrophy of muscular coat. There is also a mass of inflammatory tissue between peritoneum and the layer of longitudinal muscles. *P.* Peritoneum. *I. T.* Inflammatory thickening. *L. M.* Longitudinal muscular coat. *C. M.* Circular muscular coat.

distal to the point of flexion and stricture. The proximal portion, which is larger, shows the lumen of the appendix. In the part beyond the flexure are seen traces of remaining mucous membrane, but there is no lumen. Fig. 14 is a transverse section of the same appendix, taken beyond the point of flexure. In this the lumen has been entirely obliterated; there is great thickening of the muscular coat, and there remain only a few

epithelial cells in the central portion of the appendix to mark the location of the former lumen.

Fig. 15 is a transverse section of the same appendix as Figs. 13 and 14, being proximal to the point of stricture. The muscular coat of Fig. 14 (the distal section) will be seen to be much thicker than that of Fig. 15 (the proximal section).

FIG. 13.



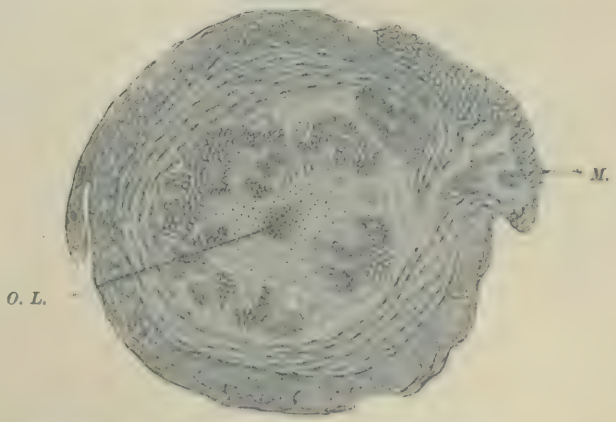
Appendix removed for repeated slight attacks.

Longitudinal section. Diagnosis was made of salpingitis and appendicitis. Diagnosis was verified at operation. Distal portion of the appendix was flexed and strictured, but not distended. The larger proximal end shows lumen open. In smaller distal end lumen is obliterated and shows only a few remaining epithelial cells. The lumen is undergoing obliteration, the process being nearly completed. *P.* Proximal end. *D.* Distal end. *L.* Remaining lumen. *O.* Obliterated lumen.

Fig. 16 is a longitudinal section taken from an appendix, in the extremity of which the lumen has been almost obliterated by an inflammatory process. The patient suffered from constant uneasiness in the cæcal region, and any over-exertion brought on pain. On opening the abdomen the appendix was found in a flexed position, the distal third of the appendix having its lumen nearly obliterated by the inflammatory process. The

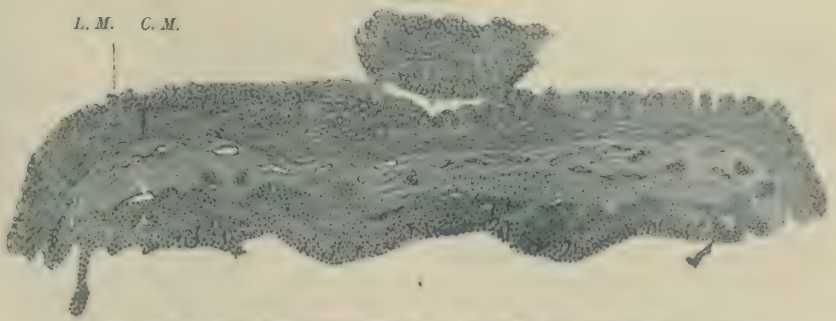
specimen shows that the mucous coat is almost entirely destroyed, only a few cells remaining. Extensive tissue changes have also taken place. Probably, had no operation been performed, this appendix would have finally become obliterated.

FIG. 14.



Transverse section of same appendix as Fig. 13. Distal to stricture. Lumen obliterated, only a few epithelial cells remaining in centre. *O. L.* Obliterated lumen. *M.* Mesentery.

FIG. 15



Transverse section of same appendix as Fig. 13 and Fig. 14. Proximal to stricture. Muscular coat not so thick as Fig. 14. *L. M.* Longitudinal muscular fibres. *C. M.* Circular muscular fibres.

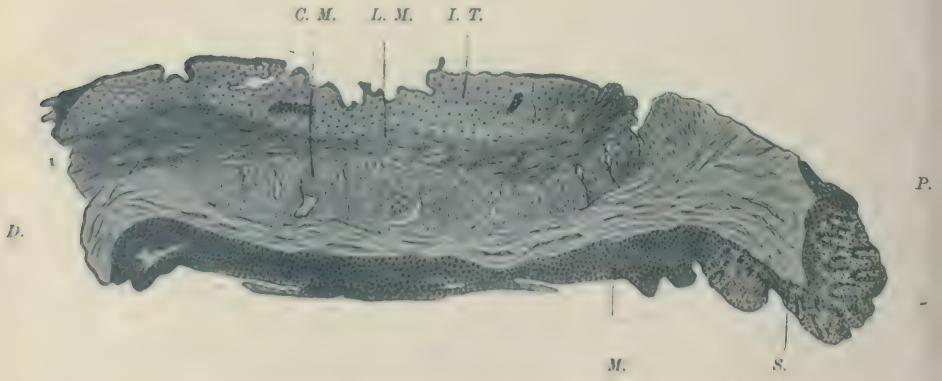
Fig. 17 is taken from an appendix which was perforated, forming a localized abscess. Only a little of the deeper portion of the mucous coat remains, save at one extremity of the specimen.

FIG. 16.

Longitudinal section of appendix removed after repeated attacks of inflammation.

These were not severe. No perforation or abscess. Was flexed and strictured. Distal end not distended. Mucous membrane was nearly destroyed. Process of obliteration was going on. *P.* Proximal portion. *D.* Distal portion. *M.* Remains of mucous tissue. *S.* Stricture with greatly developed cicatricial tissue.

FIG. 17.



Longitudinal section removed after repeated attacks of inflammation.

Appendix was perforated and had local abscess just beyond the point of stricture. Muscular coats are hypertrophied. There is a layer of inflammatory tissue between peritoneum and longitudinal muscular coat. The mucous coat is nearly destroyed, except at the point of stricture. *D.* Distal end. *P.* Proximal end. *M.* Mucous coat. *I. T.* Inflammatory thickening. *L. M.* Longitudinal muscular fibres. *C. M.* Circular muscular coat. *S.* Stricture.

The crypts of Lieberkühn are just at the stricture. The lumen of the extremity of the appendix was distended with pus. Probably the pressure had been so great as to destroy the mucous membrane before perforation took place.

The difficulty of making all drawings so accurate as to permit a comparison of the thickness of their corresponding coats has led to the adoption of another method of illustrating this point. For this purpose I have in various specimens made absolutely exact measurements with the camera-lucida of the relative thickness of the combined circular and longitudinal muscular coats. A glance at the accompanying diagram (Fig. 18) will make clear

FIG. 18.

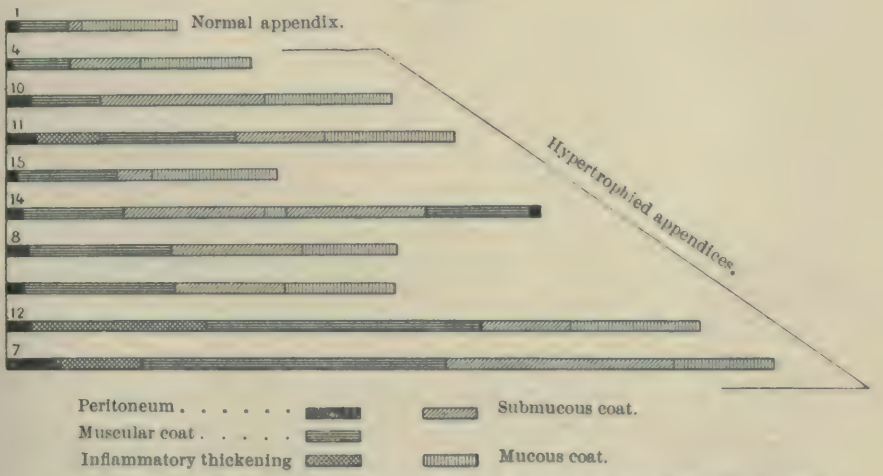


Diagram represents measurements made to the same scale to illustrate the thickness of the various coats of the appendix. The numbers correspond to those described in the text. No. 14 is a transverse section of an entire appendix. The others represent only one wall. The central portion of No. 14 represents the few remaining mucous cells marking the obliterated lumen. No. 7 shows an hypertrophy of the muscular coat amounting in thickness to about five times that of No. 1.

this point. If the normal appendix be compared with those which follow, several facts will be noticed. In the first place, there is very little change in the thickness of the peritoneum in any of the specimens excepting the last. In the last two measurements will be noticed a marked inflammatory thicken-

ing taking place between the peritoneal and muscular coats. The muscular coats will be found to have increased in thickness in each successive specimen, so that from 4 cm. in the normal appendix, the muscular coat has thickened to 19½ cm. in the last. This measurement in centimetres refers, of course, to the greatly magnified diameters recorded by the camera lucida. The history of the various specimens also shows that the thickness of the muscular coat corresponds to the frequency and severity of the attacks of appendicitis from which the patients have suffered.

The foregoing specimens have led me to conclude that the following is a reasonable explanation of the conditions which are found. The first step in the process is a bend in the appendix. If this conclusion is correct, it seems to me that the remaining steps are clear. This may be illustrated by means of a piece of garden-hose. If there be a kink in the hose the water does not flow through it. With the increased pressure, however, the force of the water may be sufficient to straighten out the bend and make the hose permeable. It is not difficult to suppose that the same condition may exist in the appendix. In the first place there is a flexion of the appendix. This may be sufficient to prevent the passage of material from the distal to the proximal portion, and it is fair to suppose that inasmuch as the appendix is lined with mucous membrane, it secretes mucus as do other portions of the intestinal tract. If this cannot escape either on account of a stricture or on account of a concretion which is too large to pass into the large bowel, a condition of pressure arises. The effort of the appendix to free itself from this condition of over-distention produces the periodic attacks of pain, which may be compared to colic. The attacks of pain may be repeated at intervals of a week, ten days, or two weeks, and disappear suddenly, leaving the patient feeling comfortable until another attack occurs. The sudden cessation of pain is similar to that following the passage of biliary or urinary calculi. The term colic seems a proper one, since there are often no evidences of inflammation sufficient to account for the pain. As the tension becomes greater and greater at the

point of flexure, in order to enable the appendix to empty itself, it produces gradual destruction of the mucous membrane. This destruction increases until the inflammatory process reaches the deeper layers of the appendix, and, if gradual, results in the formation of cicatricial tissue.

As the process becomes more severe on account of the closure of the lumen of the appendix by cicatricial contraction, the distention of the distal portion of the appendix may be so great as to impair its nutrition, and thus result in ulceration and at last in perforation. It is very easy to understand how this may occur by remembering the manner in which stricture of the urethra with retention may cause ulceration at the point of stricture, followed by extravasation of urine. That these conclusions are correct is strongly evidenced by the fact that at times the appendix turns rapidly gangrenous through its whole extent.

Several times I have found the entire distal portion of the appendix gangrenous and separated from the proximal portion, floating out in the water or on the sponges used in cleansing the abscess cavity. This explanation of the origin of appendicitis is strongly corroborated by the fact that the muscular coats of the appendix are so enormously hypertrophied. This condition can hardly have failed to attract the eye of every operator.

The part played by bacteria in the development of appendicitis seems to me to be a secondary one. After the integrity of the mucous coat lining the appendix has become impaired there is opportunity for the invasion of whatever germs may be present. The most common is the bacillus coli communis. Doubtless the virulence of infection may vary with the virulence of the bacteria present.

If, then, our interpretation of these phenomena be correct, viz., that the primary inflammatory process takes place in the mucous membrane, and later attacks the deeper coats; that the recurring attacks of pain resembling colic are the result of the effort of the appendix to free itself of its contents; that the emptying of the appendix gradually grows more and more difficult, until it becomes impossible, and that as a final result of the closure at the point of flexion perforation takes place, the

FIG. 19.

Appendix and extremity of cæcum removed at post mortem, showing embryological form. The length of the appendix is 17 cm.

question remaining for elucidation is, how the primary flexure of the appendix is produced.

As has already been stated, my belief is that the primary cause of appendicitis is a flexure of the appendix, and that this is the result of a process external to the appendix, rather than from inflammation occurring within it. From the many positions in which the appendix is found, it is evident that its location is a widely varying one. The cause for these variations in direction is in my judgment dependent upon the manner in which the appendix develops during fœtal life.

Fig. 19 represents an appendix which is simply a continuation of the cæcum. The cæcum terminates in a conical form, ending like a funnel in the appendix. The appendix measures exactly 17 cm. in length. I have in my collection another specimen removed for appendicitis, measuring 23 cm. There are reports of cases in which the appendix has not measured over 2 cm. in length, and variations occur within these two very wide limits.

Fig. 20 represents a fœtus, the cæcum still occupying the right hypochondriac region, and on comparing this with the previous illustration, it will be seen that the cæcum and appendix in the case of the embryo have exactly the same form as the long specimen shown in Fig. 18. It might not be out of place to recall in a few words the method of the formation of the alimentary canal. It will be remembered that this is primarily a straight tube, and that two bends occur in it early in fœtal life. The anterior portion of the first bend forms the pyloric orifice of the stomach. The anterior portion of the second bend forms the cæcum. A gradual increase in the length of the alimentary tract and a change of location by means of development and rotation bring the organs into the position which they ultimately occupy. In the fœtus here presented the cæcum lies just underneath the ribs on the right side, as is shown in Fig. 20. It gradually descends until at birth it occupies the right iliac fossa. The cæcum and the appendix each have an independent mesentery. It is evident from the many different positions which the appendix occupies that in the descent from the right hypochondrium to the right iliac fossa the relation of

these two organs with reference to each other become changed. An examination of many appendices removed in cases of recurring inflammation has demonstrated the fact that the appendix is often held in a position of flexure by its mesentery, so that as a natural result there must be an embarrassment to the escape of material from the distal to the proximal portion.

FIG. 20.

Abdomen of fœtus. Anterior wall removed. The cæcum occupies the right hypochondriac region, not having yet descended into the right iliac region. It still retains the embryological form of the appendix. *R.* Ribs. *L.* Liver. *C.* Cæcum. *L. I.* Large intestine. *S. I.* Small intestine. *S.* Sigmoid flexure. *U.* Urachus. *B.* Bladder. *V. U.* Vessels of umbilicus. *A. W.* Abdominal wall. *A.* Appendix.

The peritoneal covering of the appendix and the mesoappendix present a perfectly normal appearance, showing no evidences whatever of any inflammatory condition. The normal coats of the appendix and the normal appearance of the mesoappendix lead one to the conclusion that it is this shortened condition of the mesoappendix which causes a flexion of the appendix itself. Certainly the method of the development of the appendix is sufficient to account for the great variation in its position.

It is not within the province of this paper further to discuss the pathology of appendicitis. The conclusions at which it has arrived may be shown on further study to rest on insufficient data. They may, however, be briefly summarized as follows:

1. In the descent of the cæcum from the right hypochondriac to the right iliac fossa, the position of the appendix with relation to the cæcum becomes changed.

2. The bend thus produced may be sufficient to embarrass the passage of the contents of the appendix into the bowel.

3. To empty the appendix an increased effort becomes necessary on the part of the muscular coats.

4. The increased effort on the part of the muscles results in hypertrophy, amounting in one specimen presented to nearly five diameters.

5. Increased pressure at the point of flexure produces irritation and inflammation, causing gradual destruction of mucous membrane, and at length organic stricture.

6. The hindrance to the escape of mucus produces the repeated attacks of pain resembling colic.

7. When the discharge of the contents of the appendix into the bowel is no longer possible, either from the tightness of the stricture or because it is closed by a concretion too large to escape, distention of the distal portion may gradually go on to perforation or, if the distention be rapid and extreme, to gangrene.

8. In some cases the inflammatory process may not cause perforation, but terminate in destruction of the mucous coat and final obliteration of the lumen of the appendix.

[Note.—The illustrations are from drawings made by Miss Alice S. Cleveland.]

A CASE OF CHRONIC INTESTINAL OBSTRUCTION FROM INCOMPLETE VOLVULUS OF THE SIGMOID FLEXURE.

Reduction and Fixation; Recovery. Recurrence of Twisting and Obstruction; Resection of the Whole Coil; End-to-end Suture; Recovery.

By MAURICE H. RICHARDSON, M.D.,
BOSTON.

Intestinal obstructions from a complete twist seem to be very infrequent. Even at the Massachusetts General Hospital, where within the last ten years almost every acute intestinal lesion has occurred, the emergency has, as far as I know, never arisen. Enlargement of the sigmoid flexure, with elongation of its mesentery, unaccompanied by obstruction, is not uncommon. In a dissecting-room subject, some years ago, I found a sigmoid flexure which filled the upper part of the abdomen. It was somewhat distended, but not in the least obstructed. The combination of distention and elongation had produced a number of sharp bends, with more or less folding of the mesocolon.

Chronic intestinal obstruction, dependent upon the gradual distention of an elongated, enlarged, and misplaced sigmoid flexure, is so rare that the following case seems worthy of being recorded:

The patient, a man, aged forty-seven years, congenitally deaf and dumb, I saw on March 22, 1897, with his physician, Dr. Hardy Phippen, of Salem. The patient's own statement of his case is as follows:

"My health was always good until the fall of 1890, when I began

to be troubled with constipation and occasionally to have watery discharges, different from diarrhœa. After two years I had severe pain in the bowels, coming on suddenly, but of short duration. These discharges became more frequent from year to year, but were not always accompanied by pain. The last two and one-half years I have had a great deal of gas and rumbling in my bowels, and occasionally a sick stomach, and the pains have been more frequent and severe, and the bowels harder to act upon. After getting a satisfactory movement the bowels felt very weak, and there was a soreness in my left side. The last six months they have been much swollen and felt very heavy; but that is all gone now, and I feel well, but not very strong yet."

This man in his business was in the habit of lifting a heavy hard-wood frame (for blue prints). The history obtained at the time from Dr. Phippen was as follows:

"He has been troubled with constipation for seven years. The last two years he thought that he had a tapeworm. There was a great deal of commotion in the intestines, which he thought was owing to the writhing of the worm (exaggerated peristalsis). Attacks of constipation would be followed by watery movements. About a month ago he took some very harsh medicines, which produced excessive catharsis. Night before last he took a large dose of castor-oil, which caused him tremendous pain. Since then we have been working with cathartics and injections, but he has passed practically no fecal matter. At first there was vomiting; now none whatever. He has taken liquid nourishment only, but he has grown more and more distended. Yesterday we aspirated and drew off large amounts of gas. The temperature was at first normal; yesterday morning it was 100°, to-day about 100°. There has been no loss of weight. The family history is good; neither cancer nor consumption in the family."

I found the abdomen very much distended; it was everywhere tympanitic. No tumor could be felt. There was no ascites. At one time the abdomen would be soft, at others it would be rigid, as if violent intestinal contractions were going on. No coils, however, could be seen. The rigidity suggested that observed in contractions of the pregnant uterus. The patient's general condition was excellent; he was well nourished; his color was good; his pulse was of good quality. There was no evidence of cachexia—either of cancer or of any other disease. It seemed likely, therefore, that the obstruction

was a mechanical one, not dependent upon malignant disease and not associated with necrotic changes in the bowel. Immediate operation was advised.

Through a median incision below the umbilicus collapsed intestines protruded below what seemed to be an enormously dilated stomach. This distended viscus, tense, dark in color, and tympanitic, occupied,

practically, the entire abdomen. Its vessels at the edge of mesenteric insertion were very large and embedded in fat, like the vessels at the pyloric end of the stomach. Enlargement of incision showed longitudinal striæ in this viscus, which proved to be the sigmoid flex-

ure excessively distended. Large quantities of gas were withdrawn through an aspirating needle, whereupon the collapsed gut was easily delivered. The gut was found to be twisted half a turn about its mesentery. There was just enough of a kink in the mesentery to prevent the passage of feces, but not enough to shut off the arterial supply, although the mesocolon was there opaque and œdematous from obstructed venous return. After straightening out the sigmoid flexure it was clear that there was no other obstruction, for the gas and feces began immediately to pass into the rectum. The coil was emptied as much as possible by squeezing its contents out of the anus through a large rectal-tube.

After the sigmoid flexure had been collapsed it was placed in as natural a position as possible and fastened there by numerous silk sutures passed through the anterior surface of the coil into the edges of the abdominal incision.

The patient made a good recovery from the operation. He gained in health and strength. He was able to attend to his business. The bowels moved freely and regularly; there was no pain.

On Friday, August 6, 1897, he was again seized with pain and vomiting. The bowels were completely obstructed; the abdomen rapidly became distended. The temperature rose to 101°. It was evident that the distended sigmoid flexure was again taking up the greater part of the abdomen.

On Monday, August 9th, I found Mr. C. with a pulse of 80, a temperature of 101°. The abdomen was filled by the tympanitic and resistant sigmoid coil. Every means failed to empty the gut. It was impossible to pass the rectal tube into the affected coil. It seemed clear that the twist had recurred either from giving way of the sutures or in spite of the fixation. After consultation with Drs. Phippen, Peirson, and Brewster, it was agreed that no method of procedure less radical than the complete removal of the dilated coil was worth considering; that, as a thorough and satisfactory fixation had failed, it was hardly worth while to repeat the operation; moreover, that measures for diminishing the size similar to those used in a dilated stomach offered no reasonable prospect of success. Nor was it possible to shorten a mesentery already thickened, œdematous, and fixed.

It was finally decided, therefore, to remove the sigmoid flexure unless exploration should show some good reason for not doing so. An incision from the pubes to the umbilicus showed the lower portion of

the coil pointing toward the rectum. The fixation had entirely disappeared; not even the remains of the sutures or the seat of attachment could be seen. The peritoneum was smooth and unaffected. The abdomen was found almost entirely filled by the sigmoid flexure, which was thickened and enormously distended; the contiguous surfaces of the sigmoid, with the mesentery, were firmly adherent. There was just enough rotation about the mesentery to obstruct both upper and lower portions, but not enough to cut off the circulation. It was evident, too, that the chief and earlier obstruction was at the lower part, the entrance to the coil remaining patent until the flexure, partly filled and sagging, brought about the complete isolation of the affected coil. Œdema of the bowel wall, with gas formation, increased the distention to an excessive degree. The intestines above the coil were not distended; the rectum was empty.

The descending colon and the rectum were cut across at planes which admitted easy approximation. The mesentery of the sigmoid flexure was then tied in sections and the coil itself removed. Escape of fecal matter was restrained by means of rubber ligatures. A satisfactory end-to-end suture was made. The joint was protected by means of gauze, which projected from the lower angle of the wound.

The patient withstood the operation (which lasted an hour) with very little shock.

The pathologist's report is as follows:

	Sigmoid flexure.
"Length at mesenteric border	37 c.m.
Length at outer border	74 c.m.
Largest circumference	44 c.m.
Capacity (distended)	3500 c.c.

"External surface shows some injection and some thickening of peritoneum. Gut contained much light-yellow, soft, homogeneous feces.

"Internally the sacculi and folds of mucous membrane were largely obliterated. Considerable injection in spots."

The patient made a very satisfactory recovery.

A FLOATING KIDNEY CONTAINING THREE DERMOID CYSTS AND SEVERAL SEROUS CYSTS; LAPAROTOMY; RECOVERY.

By E. W. WALKER, M.D.,
CINCINNATI.

In June, 1895, a girl, eleven years of age, was admitted to the Episcopal Hospital for Children with the following history: For several years she had been subject to severe attacks of what the physicians attending her called colic. These attacks lasted several days, confining her to bed. They were generally accompanied by nausea, vomiting, and obstinate constipation. Tympanites was always present. There was marked irritability of the bladder during each of these attacks; this symptom was especially noted by the mother. The child located the pain in the left lumbar region, radiating from there up the chest and down the thigh. Last summer, during an attack of colic, so-called, the physician called in noticed a tumor in the left lumbar region. His diagnosis of the trouble was fecal impaction. After the symptoms had subsided she felt as well as ever and continued her schooling.

When admitted to the hospital the child was well nourished. The pain was intense, located principally in the left lumbar region. Her temperature was 99°, pulse 110. The abdomen was tympanitic. Marked tenderness was also present. Palpation showed the presence of a tumor in the left lumbar region. The examination at this time was not thorough on account of the great pain produced. After being in the house for ten days all the symptoms disappeared, but the tumor still remained. The child was anæsthetized, and by bimanual examination and examination with a sound, its connection with the uterus or bladder was ruled out. Under ether the mass was found freely movable. An examination of the urine at the time of her entrance into the hospital was made. The quantity and specific gravity were nor-

mal. No albumin nor sugar present. Microscopic examination negative. After being in the house three weeks and under careful observation, all of the acute symptoms subsided. No positive diagnosis had been made.

The mother consenting, an exploratory laparotomy was made July 15, 1895. The incision was made in the median line about four inches in length. The tumor presented itself after opening the cavity. It was about the size of a large orange. There were several fragile adhesions between the tumor and the small intestines. These adhesions were readily torn through, and very little bleeding followed this tearing. The pedicle of the tumor was probably four to five inches in length, giving it a considerable range of motion. The pedicle was about the size of a small lead pencil. The tumor presented on its surface a cyst, which was aspirated before the tumor was removed. It contained about six ounces of a reddish fluid. The tapping of this cyst so reduced the size of the tumor that it could be easily brought out through the incision. This fluid was unfortunately not examined, one of the attendants having unwittingly emptied the vessel containing it. The pedicle was ligated a short distance from the tumor and dropped back. In the pedicle, which ran back to the groove along the spinal column, was found an artery, a vein, connective tissue, and an atrophied closed tube. After the tumor had been removed the abdominal wound was closed with silkworm-gut sutures. On the seventh day the dressing was changed and the stitches removed. The patient made a perfect recovery, and at the end of four weeks went home well.

Immediately after the operation the only symptoms to be noted were nausea and vomiting for several days, and a marked irritability of the bladder. The patient had to pass water every hour for the first few days. Gradually the bladder regained its normal tone, and when discharged this troublesome symptom had entirely disappeared.

The urine was examined several times during convalescence, and was found normal as regards quantity and specific gravity. Chemical and microscopic examination showed nothing abnormal. After the removal of the tumor the right kidney was examined by palpation. It was found in the normal position, possibly somewhat hypertrophied. Both ovaries were looked at and found normal. An examination of the specimen shows

several small cysts containing a reddish fluid. Besides these cysts, three dermoid cysts were found scattered throughout the kidney substance. These cysts were about the size of an English walnut, and contained hair and fat. Almost the whole of the secreting substance of this kidney had been replaced by these cysts. The secreting power of this kidney was nil.

An examination of the pedicle showed that it had twisted on itself. In all probability all of the previous attacks had been caused by this condition. The last attack being the longest and most severe, the twisting of the pedicle caused a pressure on the vessels, more on the vein than the artery; this led to a passive congestion of the kidney. This congestion caused a plastic exudation, which united the kidney with the intestines as described above. What was formerly a floating kidney became a fixed one, not fixed in the normal position, but tied down by adhesions to the intestines. The paroxysms of pain, gastro-intestinal symptoms, frequent desire to pass water, in fact, the whole chain of symptoms present during each attack is easily accounted for by the condition found.

The condition found in this kidney was undoubtedly congenital. The position of the kidney floating in the peritoneal cavity was also congenital. As the cysts increased in size the kidney became heavier and the pedicle elongated gradually. At the time of operation there was a well-developed meso-nephron, giving the mass a large range of motion. In sub-peritoneal fibroids of the uterus the same thing occurs. As the tumor grows it becomes pedunculated, stretching the peritoneum as it grows.

In regard to the operation performed in this case the result justifies the course taken.

As stated before, the operation was an exploratory one. As soon as the tumor was examined it was recognized as a kidney. The ovaries were both present. The meso-nephron was attached where it ought to be. The shape was characteristic of the kidney. By an incision in the loin it would have been almost impossible to remove the organ. The peritoneum would have been as much disturbed and the field of vision much less in

the lumbar incision than in the incision in the median line. Nephrorrhaphy, or anchoring the kidney was not justifiable in this case for one special reason, the secreting substance was almost entirely destroyed by the cystic change.

Leaving a kidney anchored as this one was, was a constant menace to the child. The danger of intestinal obstruction from pressure of an internal hernia was always present. A further twisting of the pedicle, which possibly might occur, might have caused a gangrene of the mass. The cyst might have ruptured at any time.

Two things were overlooked that ought to have been looked into in this case.

As stated before, the fluid in the large cyst that was tapped before the removal of the growth was not examined. The fluid was of a dark-red color. About six ounces was removed. The vessel containing the fluid was unintentionally emptied.

Again, no cystoscopic examination was made. This examination might have determined the amount of functional activity of the kidney, if any, and helped greatly the diagnosis before operation.

That floating kidney is rare no one can gainsay.

Lawson Tait, in the *British Medical Journal*, November, 1887, says on this subject: "I put floating kidney altogether to one side. I have never seen the thing, either in life or in a museum, nor have I seen any one that has; in fact, I have no belief in its existence as a pathological incident."

J. William White, in Dennis' *Surgery*, says: "Whether or not a congenital floating kidney can be successfully cured by the operation usually employed for the relief of movable kidney is yet to be proved. The operation is quite new to surgery, and extremely few cases of true floating kidney have been recognized before death."

Dermold cyst of the kidney is also extremely rare. One case has been reported by Paget. None of the text-books mention the occurrence of such a condition. In fact, the combination of a dermoid cyst in a floating kidney makes a condition which is unheard of (as far as I can find) in the annals of path-

ology or surgery. So rare is such a condition that I have been almost afraid to report the case as such. Yet the gross appearance, the clinical history, and the microscopic examination, in itself almost positive of the structure remaining, make the diagnosis so positive that I do not think any one could doubt the diagnosis made, viz., a floating kidney with dermoid and serous cysts.

In reviewing the literature on the subject of floating kidney, the terms movable and floating kidney are used as interchangeable terms. Yet the frequency of movable kidney as compared with floating kidney shows such a difference that these terms ought to be strictly limited. The best classification seems to be Newman's. He divides them into three classes:

1. Simple displacement without mobility of the organ.

2. Movable kidney in which, although behind the peritoneum, it has a certain range of motion.

3. Floating kidney, a congenital condition, in which the kidney has a well-formed meso-nephron, giving it a large range of motion.

The first of these classes, simple displacement, occurs quite frequently—twenty-four out of one-thousand post-mortems.

The second class, or movable kidney, was found one out of one thousand post-mortems.

The third variety is very rare, some authorities denying its existence at all.

The conclusions to be drawn from the points in the paper are as follows:

1. A distinction ought to be made between the terms displaced, movable, and floating kidney.

2. Floating kidney, although rare, does occur.

3. Floating kidney proper cannot be reached without opening the peritoneum. Movable kidney can generally be reached by an incision in the loin without opening the peritoneum.

4. As floating kidney is always congenital, if its secreting function is interfered with by any change in the kidney substance, the remaining kidney enlarging readily secretes the normal quantity of urine.

5. In floating kidney with a long meso-nephron, if nephrectomy is decided upon, the incision in the median line will be probably the easiest and safest operation.

Pathological Report. The following measurements and description are from the specimen after being hardened in alcohol:

The tumor has decidedly a reniform shape. It was four and one-half inches in length, two and one-half inches in breadth at hilum, and one and three-fourths inches in thickness. About two-thirds of this was taken up by the large cyst, which had to be aspirated before removal. The remaining one-third was of a much firmer consistency. The hilum was occupied by a thickened mass resembling obliterated vessels, but no distinct lumen could be made out. On laying open the tumor by the usual incision for the kidney, the pelvis was found to contain three smaller cysts, the larger, one and one-half inches in diameter, being filled with a reddish friable mass resembling coagulated blood. The middle one, quite small, contained a watery fluid, while the third, about three-fourths of an inch in diameter, was filled with a white, fatty material and fine hair, varying from a quite light to a dark color. The fatty material contained epithelial cells, fat crystals, and cholesterine crystals.

The more solid portion also contained cysts, one adjoining the above cyst and similar to it in size and contents; one quite narrow and similar to the second cyst above, and a third, made up partly of solid tissue and partly of softer fatty material and hair. This was one and one-half inches in diameter. The solid part was quite firm, and was made up of a red portion with a central yellow layer; the latter was found to be similar in make-up to the white, fatty material, but was much firmer. This combined red and yellow layer was folded compactly in a cavity, and about its outer globular surface was a layer of white, fatty material containing hair. About the entire tumor was a distinct capsule, which could be stripped off. The solid part of the tumor at no point was thicker than one-fourth of an inch, and had a firm and decided fleshy appearance.

The microscopical examination of the solid parts of the

tumor revealed no typical kidney structure, though this, in a congenital tumor, is hardly to be expected. In some portions there was found a tubular arrangement, but irregularly distributed. In other portions were embryonal connective-tissue cells, spindle cells, ganglionic cells, and pigmented cells. Nothing exactly resembling a glomerulus could be found.

Dermoid cyst of the kidney is exceedingly rare, there being but two cases on record, and one of these, reported by Schlegtendel in *Arch. f. klin. Chirurg.*, 1887, Bd. xxxvi, p. 304, is not a certain case. The other is reported by Paget in his *Surgical Pathology*, 1854, p. 369. After speaking of dermoid cysts of the ovary and subcutaneous tissue Paget goes on as follows:

"Besides these, the common seats of cutaneous cysts, perhaps any part or organ may in some instances present them, for the records of surgery and pathology would furnish abundant instances of aberrant cysts containing hair and fatty matter such as we must class with those in which the cutaneous structure and products are more perfect. The most singular and frequent of these rarer examples are in the testicle, the lung, the kidney, the bladder, and under the tongue, and within the skull or brain."

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